Technical Manual No.
799816-003
Revision M

MODEL F880 MAGNETIC TAPE TRANSPORT

VOLUME I

OPERATION MAINTENANCE

Cipher Data Products
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San Diego, California 92131

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NOTICE

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions included in this manual, may cause interference to radio communications. Verification of compliance with Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference, is the responsibility of the installer.

VOLUME I

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SECTION I

DESCRIPTION, UNPACKING, INSPECTION, AND INSTALLATION

GENERAL

1-1. The Model F880 Magnetic Tape Streamer Unit (MTSU) is a dual-speed, dual-density, tape transport manufactured by Cipher Data Products Inc., San Diego, California. It incorporates a dual-gap head, providing read-after-write capability. Read/write, control, and formatting electronics are all incorporated in a single printed-wiring board (PWB). The transport is designed to operate on 85- to 132-Vac or 195- to 263-Vac, single-phase, 48- to 61-Hz line power. Reels to 10.5 inches in diameter can be accommodated. Tape speed and density capabilities are as follows:

a. Model F880 MTSU (1600 bpi)

   (1) 25 ips at 1600 bpi

   (2) 100 ips at 1600 bpi

b. Model F880 MTSU (3200 bpi)

   (1) 25 ips at 1600 bpi

   (2) 50 ips at 3200 bpi

   (3) 100 ips at 1600 bpi

This section presents instructions for unpacking, inspecting, and installing the MTSU.

UNPACKING AND INSPECTION

1-2. The MTSU is shipped in a single carton reinforced by foam blocks to minimize the possibility of damage during shipping. Unpack as follows:

a. With shipping container on floor or workbench, cut side and center tapes securing top of outer box.

b. Pull box-top flaps down along sides of box. Lift upper foam blocks off MTSU, remove MTSU and place on table. Remove manual, I/O connector retainer, and rack latch bracket from shipping carton.

c. Check contents of shipping container against packing slip, and inspect for possible damage. **If damage exists, notify carrier.**

d. Refer to the illustration taped to the front door. Remove tape holding top cover and front door in place. Open top cover by lifting sides directly behind front panel. Place cover stay (left rear of top cover) in the slot provided. This is the maintenance access position. Pull tachometer (spring loaded arm at left-rear of unit) away from hub and discard the foam cushion. Carefully replace tachometer assembly against hub.

e. Examine the hubs, tachometer, and other components in tape path area for foreign matter.

f. Using a screwdriver, loosen two captive screws at front sides of top plate casting. Close the top cover. Lift front panel (and top plate casting) by grasping the two lower corners. Lift unit to its maximum upright position. Latch mechanism will automatically engage when unit is lowered approximately one inch. Insert the safety pin provided through both holes in the top plate support from outside inward (Figure 4-2). This is the service access position.

g. Remove 3 pieces of foam packing material from PWB. Check PWB and all connectors for correct installation.

h. To release latch mechanism, remove the safety pin and lift front panel before lowering it. Open top cover and tighten captive screws. Close top cover.

i. Do not replace packing tape or foam cushion materials.

j. Verify that the operating voltage indicated on the manufacturers label (rear of chassis) matches the power outlet voltage for the unit. If not, refer to paragraph 1-4 for instructions to change the operating voltage.

POWER CONNECTION

CAUTION

To prevent damage to the MTSU and ensure proper operation, be sure the outlet voltage is correct before applying power to the MTSU.

1-3. A power cord is supplied only for the voltage range indicated on the manufacturers label.

1-4. **Operating Voltage Selection.** The MTSU can be operated over a wide range of line voltages by selection of the appropriate power supply voltage option. To change the power supply option, proceed as follows:

CAUTION

When MTSU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of MTSU in extended position could upset an inadequately mounted equipment rack.

a. Switch transport power OFF and remove power cord from outlet.

b. Open unit to service access position. Refer to paragraph 1-2 (f).

c. Place a shop cloth or similiar item over the PWB in the area of the power supply assembly.

> Dangerous voltages can be encountered in the next two steps if the power cord is connected to an AC source or if the unit has had power applied in the last two minutes.

d. Refer to Figure 4-23. Remove two phillips head screws securing power supply cover, noting position of chassis ground cable. Pivot cover to the right and slide forward to remove.

e. Remove voltage selection card (4, Figure 4-24) from J9 on power supply PWB. Noting position of key slot on voltage selection card, reinstall the card in J9 to correspond to the desired voltage. Refer to Table 1-1.

f. Reverse steps c and d.

g. Replace the fuse, if required, with one of the correct current rating for the voltage selected. Refer to Table 1-1. Use a slo-blo, 250V type. The fuse holder is located on the right-front of the power supply assembly. Replace the power cord if required.

h. Note in a prominent location on the unit that the "operating voltage (has been) changed to _____."

NOMINAL LINE VOLTAGE (TOLERANCE)	SELECTION CARD	FUSE (AMPS)	FREQUENCY (Hz)
100 - (85 - 110)	100	3.0	49-63
120 - (102 - 132)	120	3.0	49-63
208 - (187 - 228)	220	1.5	49-63
220 - (187 - 242)	220	1.5	49-63
230 - (207 - 253)	240	1.5	49-63
240 - (204 - 264)	240	1.5	49-63

Table 1-1. Operating Voltage Selection

INITIAL CHECKOUT

1-5. Section II contains a detailed description of all controls. To check for proper operation before installation, proceed as follows:

a. Connect power cord.

b. Clean tape path as directed in paragraphs 4-4 through 4-10.

c. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 2 seconds). For other indications refer to paragraphs 2-6 and 2-7.

d. Ensure that tape is wound completely onto reel.

CAUTION

Both top cover and front panel door are locked during tape-loaded functions. Any attempt to open either top cover or front panel door before tape is unloaded will result in mechanical damage to the locking mechanism.

e. Open front panel door by pressing down gently on top (center) of door.

f. Insert tape into front panel of unit with write-enable ring side down.

g. Close front panel door.

h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

i. Initiate Service Aid 22 as described in paragraphs 3-3 and 3-27. Allow transport to cycle tape for a sufficient length of time to ensure proper servo operation. (It requires about 30 minutes to make a full pass on a 10.5 inch reel and complete a rewind sequence).

j. Exit Service Aid 22. Refer to paragraph 3-4.

k. Check that LOAD indicator remains illuminated following rewind sequence.

l. Check ON-LINE switch and indicator by depressing repeatedly and observing that ON-LINE indicator is alternately illuminated and extinguished. Leave in OFF-LINE state (indicator extinguished).

m. Press UNLOAD switch. When the tape is unloaded (UNLOAD indicator illuminated) open front panel door and remove tape reel. Close front panel door.

n. Switch power off and remove power cord from outlet.

RACK MOUNTING

1-6. The MTSU is designed to be mounted in a standard, 19-inch-wide, EIA equipment rack using the slides and mounting hardware provided with each unit. The tape drive unit must be mounted with no front panel obstructions. Free air supplied to the front of the unit air intake must have a pressure resistance less than 0.01 inches of water. The ambient temperature relative to the tape drive unit during operation must be 32^{o} centigrade maximum. Refer to Figure 1-1 and drawing in Installation Hardware Package to mount the unit as follows:

a. Locate the front and rear rail holes to be used on the equipment rack (1, Figure 1-1). If they are threaded, drill them out to 0.281 inches.

b. Place the transport in service access position. Refer to paragraph 4-3.

c. Starting with either side, remove stationary section of slide (2) from transport by pulling stationary section to the front of transport.

d. Remove intermediate section of slide (3) from transport by pulling intermediate section to the rear of transport. When spring lock engages, depress to release.

e. Reassemble these sections by sliding front of intermediate section into rear of stationary section. Depress spring lock to slide completely together. Leave these sections assembled.

f. Determine, for the depth of rack, the appropriate holes to use in the mounting bracket and secure loosely to stationary section using two 10-32 X 3/8 binder head screws (4) and a nut plate (5).

g. Mount front flange of stationary section (2) to front rail by placing flange behind rack rail holes.

h. Install two 10-32 X 3/8 binder head screws (6), first through front of rail, then through stationary section flange and secure loosely with a nut plate (7).

i. Mount mounting bracket to rear of rack by placing flange in front of rack rail holes.

j. Install two 10-32 X 3/8 binder head screws (8), first through back of rack, then through mounting bracket flange and secure loosely with a nut plate (9).

k. Check alignment and correct as necessary. Tighten front, rear, and mounting bracket attachment screws.

l. Repeat steps b through j for other side.

m. Install the bottom edge of the rack latch bracket (10) on the left rail 2.13 inches below the center-line of slide using two 6-32 X 7/16 flat head screws (11), flat washers (12), split-lock washers (13) and No. 6 hex nuts (14).

n. Slide intermediate sections forward until locks engage.

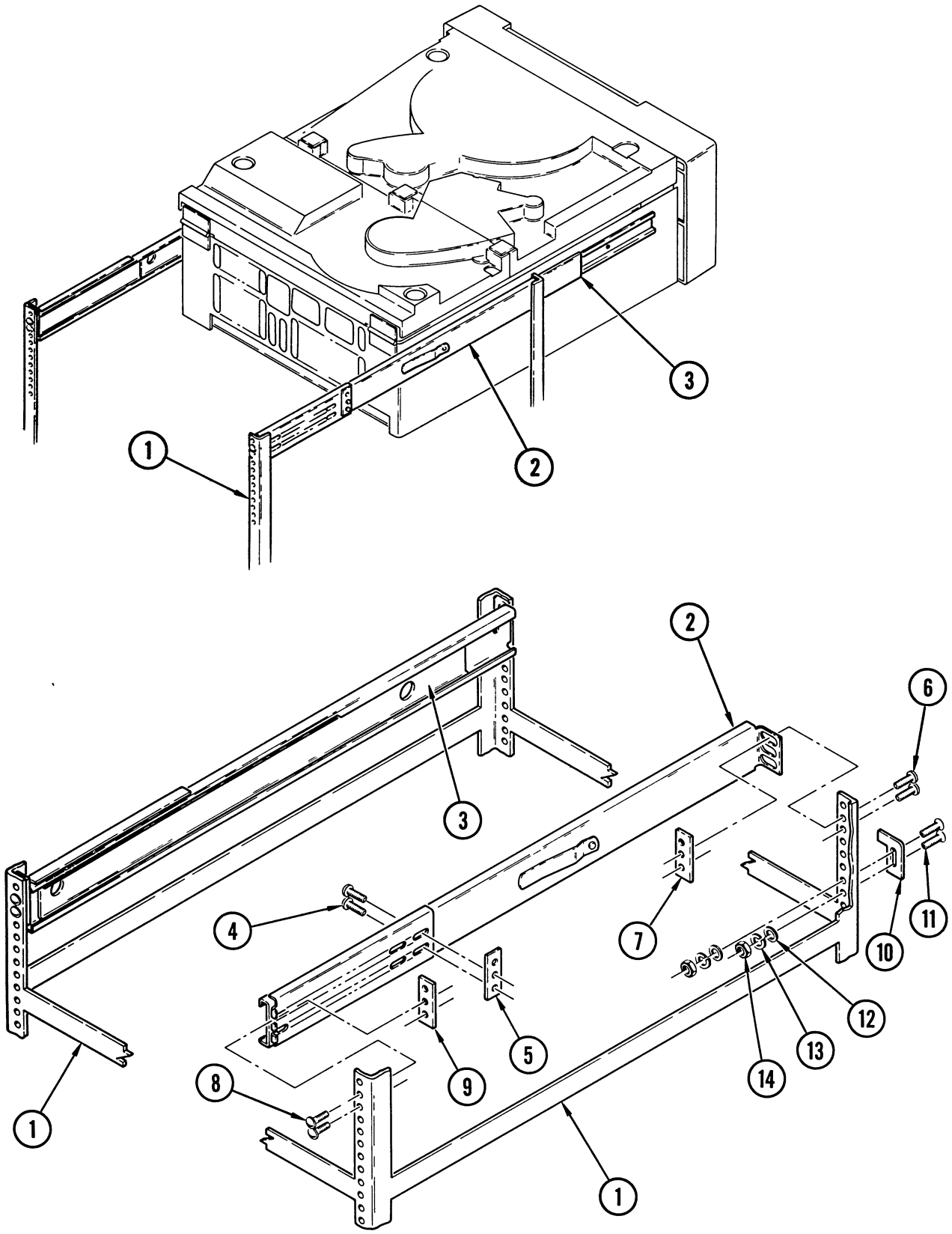

Figure 1-1. Rack Mounting

o. Carefully slide the MTSU's transport-attached chassis mount sections (15) into intermediate sections while checking for binding or interference. Release locks and, before closing fully, check that the rack latch will engage securely.

p. Adjust rack latch bracket (10) or slides as required. To release, squeeze rack latch plate inside air duct opening at lower left of front panel.

q. Connect the power cord. A service loop must be provided. Ensure the cord will not chafe or interfere with other equipment.

INTERFACE CONNECTIONS

1-7. It is recommended that interconnection of the MTSU and customer equipment be made with a flat ribbon cable or a harness of individual twisted pairs, each with the following characteristics:

a. Maximum length of 25 feet.

b. Not less than one twist per inch when using twisted pair.

c. 22- or 24-gauge conductor with minimum insulation thickness of 0.01 inch on twisted pair cables.

d. 28-gauge conductor is used with flat ribbon cable.

1-8. It is important that the ground side of each twisted pair, or the alternate conductor in a ribbon connector, be grounded. The mating connector (3M Company Part No. 3415-0001 or equivalent) must be wired by the customer. For twisted-pair cables, connector (Viking Part No. 3VT25/og JNH12 or equivalent) should be used.

1-9. Strain relief for flat-ribbon interface cables is provided for by the retainer included in the mounting hardware package. Install the connector retainer as follows:

a. Insert spring-loaded pins into holes located at each corner of PWB.

b. Lift retainer to allow access to edge connectors.

c. Install ribbon cables so that cables are on bottom sides of mating connectors.

d. Lower retainer and position over back sides of I/O connectors.

MULTIPLE-TRANSPORT OPERATION

1-10. The MTSU may be configured to allow operation of up to eight transports with a single controller. Use cables similar to those described in paragraph 1-7 for interconnection of transports. Refer to Figures 1-3 and 1-4.

1-11. To configure the MTSU to operate on a multiple transport system, proceed as follows:

a. Place MTSU in service access position. (See paragraph 4-4.)

b. Remove terminator resistor pack U3W and U10W (Figure 1-4) from each transport except last unit.

c. Install interconnection cables as shown in Figure 1-4.

1-12. The transport is selected by a combination of the levels on the IFAD, ITAD0, and ITAD 1 lines and the position of switches S1, S2, and S4 of U8W. Refer to Table 1-2 for address decoding.

ADDRESS	IFAD	ITAD 0	ITAD 1	S1	S2	S4
0	0	0	0	1	1	1
1	0	0	1	1	1	0
2	0	1	0	1	0	1
3	0	1	1	1	0	0
4	1	0	0	0	1	1
5	1	0	1	0	1	0
6	1	1	0	0	0	1
7	1	1	1	0	0	0
	0 = False Interface Level 1 = True Interface Level			0 = Open 1 = Closed		

Table 1-2. Address Line Decoding

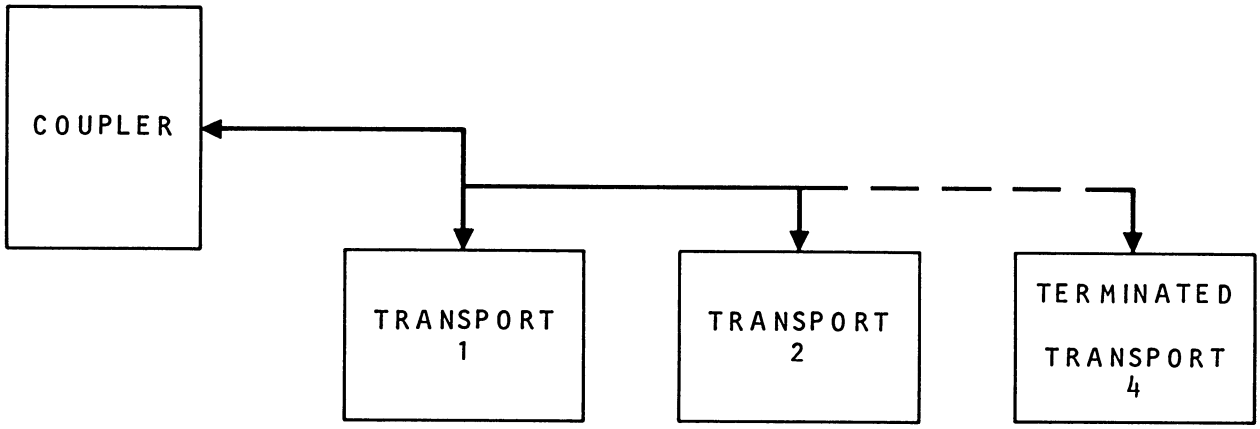

Figure 1-2. Daisy Chain Configuration

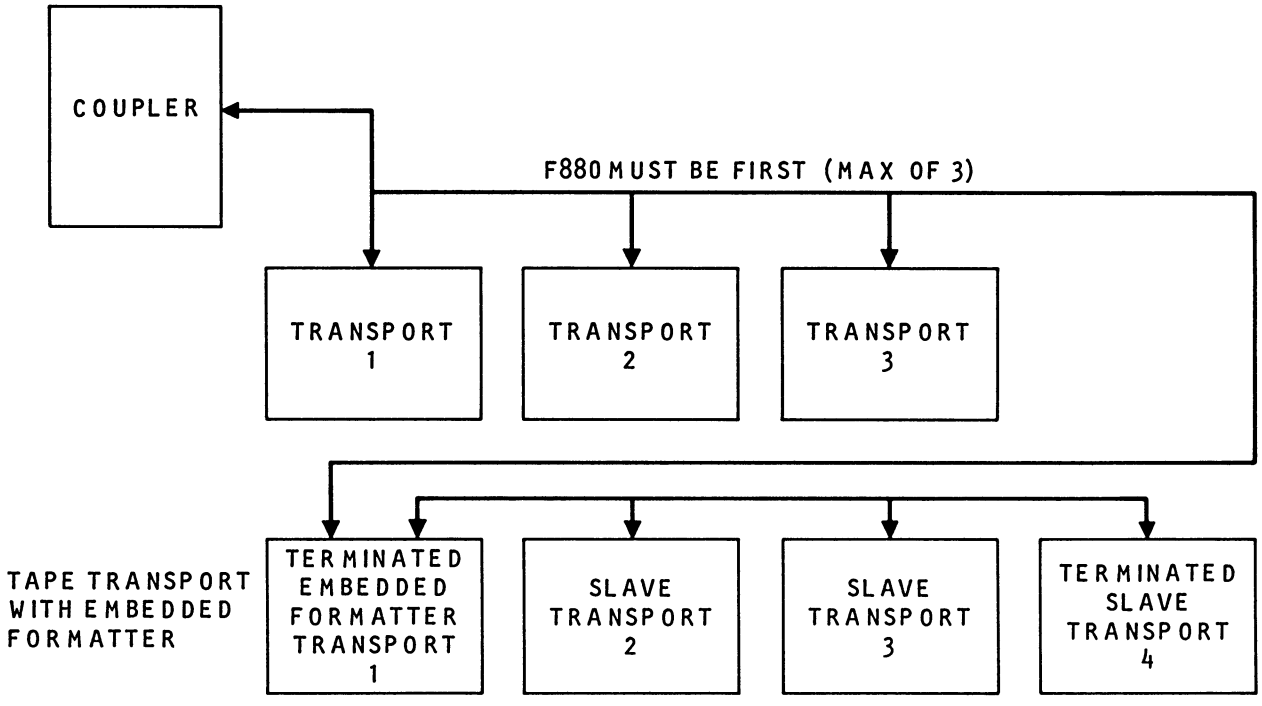

Figure 1-3. Daisy Chain with Embedded Formatted Drive

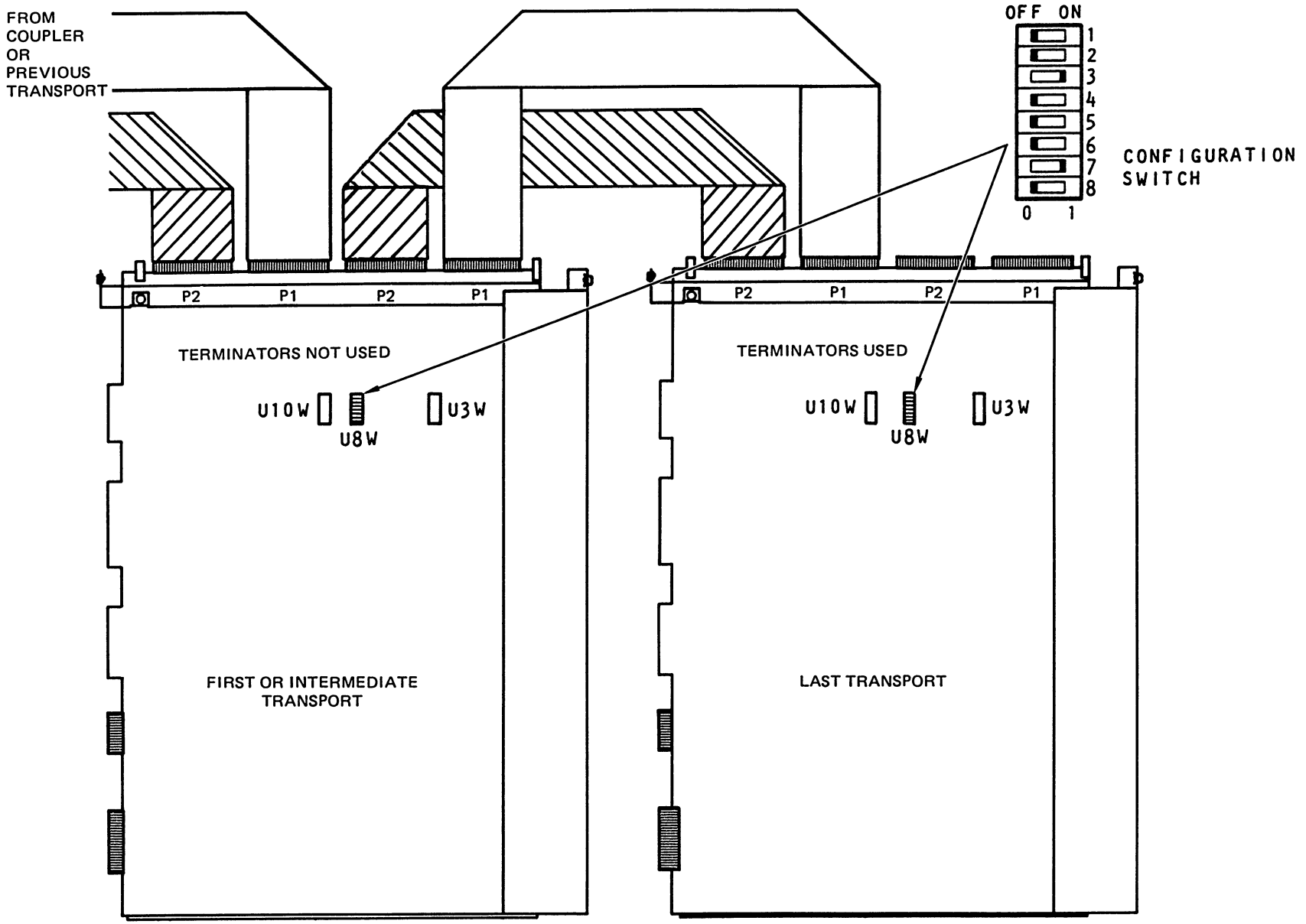

Figure 1-4. Daisy Chain Cable Configuration

SECTION II

OPERATION

GENERAL

2-1. This section describes the controls and indicators of the MTSU and provides operating instructions.

CONTROLS AND INDICATORS

2-2. Control/indicator types, functions, and the conditions required for enabling the corresponding functions are given in Table 2-1. Figure 2-1 shows the controls and indicators.

LOADING TAPE

2-3. To load tape, proceed as follows:

CAUTION

Do not attempt to open either top cover or front-panel door during load operation or while tape is loaded in transport. Both front-panel door and top cover are locked during tape-loaded functions.

a. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 2 seconds.)

b. Insure that tape is wound completely onto reel.

c. Open front-panel door by pressing down gently on top (center) of door.

d. Insert tape into front of unit with write-enable ring side down.

e. Close front-panel door.

f. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	ON/OFF Rocker Switch and Indicator	Switches line power on and off.	Fuse installed. Line cord connected.
LOAD REWIND	Tactile Switch and indicator	Loads tape to BOT marker. Rewinds tape to BOT marker. Illuminates to indicate BOT tab is positioned at photo-sensor. When pulsing, transport is executing a load or a rewind sequence.	Tape inserted in front panel door. Top cover and front panel door closed. Transport in off-line mode (ON-LINE indicator not illuminated).
UNLOAD	Tactile Switch and Indicator	Unloads tape from any point. UNLOAD indicator flashes during unload sequence, then remains illuminated.	Transport in off-line mode. (ON-LINE indicator not illuminated.)
ON-LINE	Tactile Switch and Indicator	Switches transport to on-line mode. Illuminates to indicate transport is on line. Second actuation switches transport off line. Indicator extinguished to indicate transport is off line.	During load sequence actuation of ON-LINE switch will place transport on line when BOT marker is sensed. Transport is in on-line mode. (ON-LINE indicator illuminated.)
TEST	Tactile Switch	Selects alternate operational mode for other switches.	Refer to paragraph 3-3.
WRT EN (Write Enable)	Indicator	Illuminates to indicate write function may be performed.	Tape reel write enable ring installed mounted on supply hub and tape loaded.
HI DEN (High Density)	Tactile Switch and Indicator	First actuation (indicator illuminated): high-density mode, 3200 bpi; second actuation (indicator extinguished): lower density , 1600 bpi.	3200 bpi transport must be in off-line mode (ON-LINE indicator extinguished.)

Table 2-1. Controls and Indicators

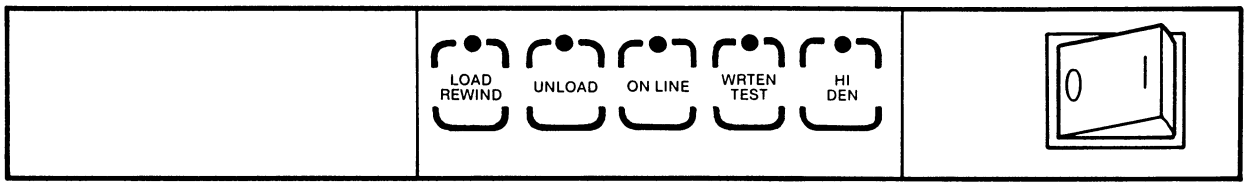

Figure 2-1. Control Panel

UNLOADING TAPE

NOTE

Transport must be in off-line mode (ON-LINE indicator extinguished).

2-4. To unload tape, proceed as follows:

a. Actuate UNLOAD switch.

NOTE

During the unload sequence, UNLOAD indicator will pulse and access doors will remain locked. When the unload sequence is completed, UNLOAD indicator will remain illuminated and access doors will unlock.

b. Open front-panel door when UNLOAD indicator remains illuminated.

c. Carefully remove tape reel.

d. Close front-panel door.

ERROR CONDITIONS

2-5. Operating failures or fault conditions are indicated by various front panel display patterns. There are two groups of error indications: those which are normally caused by the operator and can be avoided by following the proper operating procedure, and those which are machine malfunctions and require correction by an experienced service technician.

2-6. **Operator Error Codes.** These error indications are those which occur during normal tape loading operation and are usually caused by operator error. They produce error codes which will be displayed as an even, ON/OFF pattern of the indicators on the front panel. Refer to Table 2-2.

2-7. **Transport Error Codes.** These codes indicate a serious deviation from the normal operating routine of the MTSU. Each error code is represented as a unique binary pattern of the front panel indicators, which flash a quick double-pulse to alert the operator. Refer to Section III for troubleshooting instructions.

INDICATION	CONDITIONS
All indicators flashing	After four attempts, the MTSU did not successfully complete the load sequence. The tape leader should be checked for excessive damage. If a second attempt at autoloading fails, refer to paragraph 3-14 for manual load instructions.
All indicators except LOAD flashing	The BOT marker was not detected within the first 35 feet of tape. The leader must be a minimum of 6 feet in length.
All indicators except UNLOAD flashing	Tape reel was inserted upside-down. The bottom of the tape reel is indicated by the presence of an insertable write-enable ring near the inside mounting radius.
All indicators except ON-LINE flashing	A load or unload operation was attempted with the front-panel door or top cover in the open position.
All indicators except TEST flashing	A load operation was attempted without inserting a tape reel into the transport.

Table 2-2. Operator Error Front Panel Indications

MANUAL LOAD

2-8. To load tape after a failure of the autoloading routine proceed as follows:

a. Extend unit on its slides to clear equipment rack.

b. Place transport in operator maintenance access position by lifting top cover sides behind front panel. Place cover stay in slot provided.

c. Place reel of tape on supply hub. Ensure that reel is evenly seated on hub.

d. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply hub clockwise until supply reel is locked in place.

e. Thread tape along path shown in Figure 2-2. Carefully move tachometer assembly carefully away from takeup hub, and, making one wrap of tape clockwise around takeup hub, gently replace tachometer assembly. Check that tape is seated correctly on guides and threaded properly over head assembly.

f. Close top cover, and place transport in normal operating position.

g. Depress and hold the HI DEN switch, then actuate the LOAD switch and release both. Tape should tension and advance forward until BOT tab is positioned at photosensor. LOAD indicator will illuminate, indicating that MTSU is ready for use.

MANUAL UNLOAD

2-9. If for any reason the MTSU cannot complete the rewind/unload sequence, the tape reel may be rewound manually as follows:

a. Place transport in operator maintenance access position. Refer to paragraph 4-2.

b. Rotate supply reel in counterclockwise direction to rewind tape onto supply reel.

c. Depress manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply reel counterclockwise until it rotates freely and can be removed from the transport.

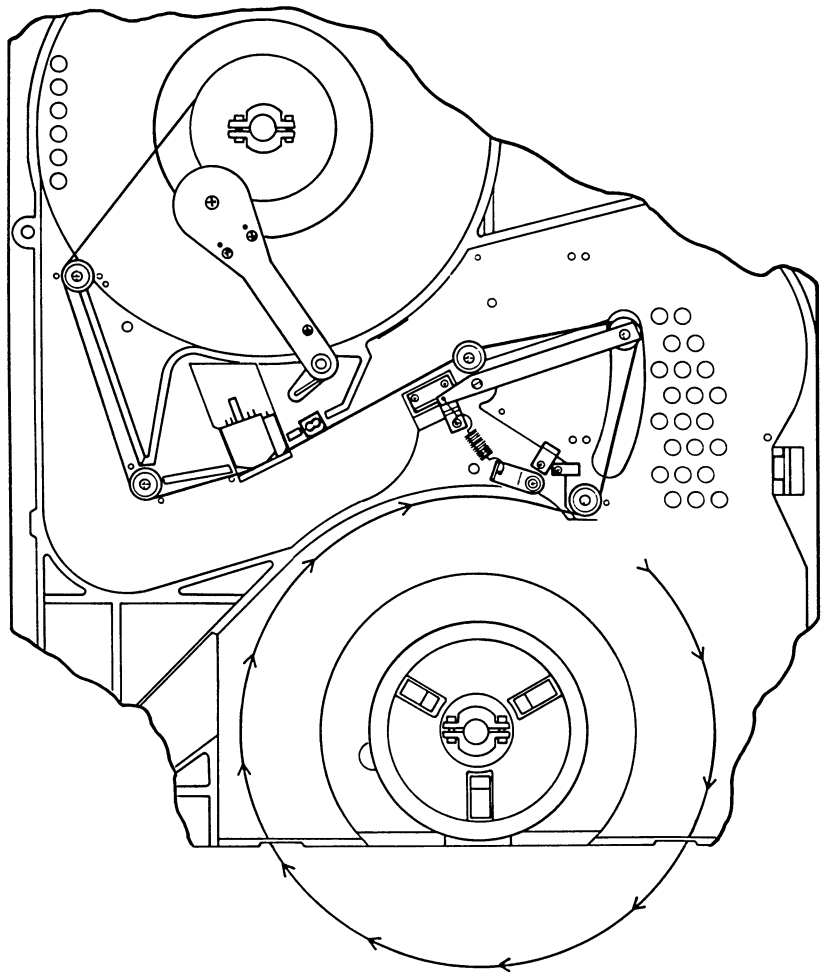

Figure 2-2. Tape Threading Path

BLANK

SECTION III

TESTING AND TROUBLESHOOTING

TESTING

3-1. The MTSU incorporates three separate types of internal testing facilities. These self-test and diagnostic systems detect certain fault conditions and provide alignment and service aids for preventive maintenance.

3-2. **Self Test.** During power-up operation all indicator lights on the front panel are illuminated for approximately 1 second. If all indicators remain extinguished except UNLOAD following this period of time, no defect is indicated. If all indicators remain illuminated, then a failure of the ROM or RAM test is indicated. The auto-zero D to A, tachometer, and takeup servo circuits are also checked during the power-up diagnostic. Refer to paragraph 3-29 for a description of error indications.

3-3. **Diagnostic Mode Operation.** Diagnostic Service Aids are separated into two groups: those performed without tape loaded, and those performed with tape loaded on the transport. These service aids are designed to aid the technician in the isolation of electrical/electronic system failures and their remedies. Refer to paragraph 3-32 for troubleshooting instructions.

3-4. Referring to Figure 3-1, which illustrates the controls of the MTSU. the switch sequence for activating each service aid is as follows:

a. Actuate transport power switch to ON.

b. Press switches 4 and 5 in sequence.

c. Press switches corresponding to test number

d. Execute diagnostic by pressing switch 5.

e. Press switch 4 to exit diagnostic mode.

3-5. **Front Panel Indicators.** During operation in the diagnostic mode, the front panel indicators provide output data relative to the service aid being performed. This data is displayed as a binary pattern with the LOAD/REWIND indicator as the least significant bit (LSB) and the HI DEN indicator as the most significant bit (MSB). For example, during diagnostic Service Aid 14 with no tape loaded on the unit, the front panel indicators could display a binary count of 8 (TEST indicator flashing), which represents a nominal tachometer quadrature phase shift of 90 degrees. See Figure 3-1.

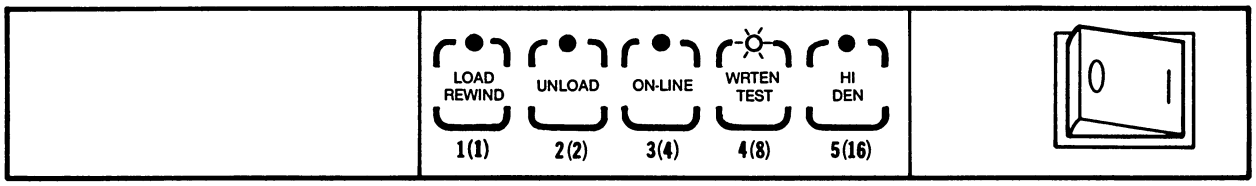

Figure 3-1. Front Panel Controls and Indicators (Diagnostic Mode)

NOTE

The complete switch sequence must be entered within 3 seconds, or the diagnostic routine will be aborted and the switch sequence will have to be reentered.

3-6. As an example, to cycle supply and takeup servos in the forward and reverse direction, Service Aid 11 would be used with no tape loaded on the unit. To access Service Aid 11 proceed as follows:

a. Actuate transport power switch to ON.

b. Press switches 4 and 5 in sequence.

c. Press switch 1 twice.

d. Execute Service Aid 11 by pressing switch 5.

3-7. **Diagnostic Mode (Tape Unloaded).** Diagnostic mode Service Aids with no tape in the transport are described in the following subparagraphs. Refer to paragraph 3-5 for description of front panel indicators.

3-8. Service Aid 11. This service aid enables both supply and takeup servo circuits, sequencing both reel hubs clockwise and counterclockwise. Press the LOAD switch to activate the high voltage rail drivers Q5 and Q6, and current limit the servos to 1 ampere. Press the UNLOAD switch to deactivate Q5 and Q6 and enable maximum current limit.

3-9. Service Aid 12. This service aid activates and deactivates the write circuitry to allow troubleshooting of the circuit with no tape loaded on the transport. To simulate a 100-ips data rate, press the LOAD switch. Actuation of the UNLOAD switch will select the 25-ips data rate. If the ILWD interface line is asserted, a 1-character pattern is written, including preamble and postamble.

3-10. Service Aid 13. This service aid performs the same functions as Service Aid 12, except the file-mark circuits are exercised.

3-11. Service Aid 14. Only the takeup servo is activated in this service aid. The purpose of this service aid is to sample the phase relationship for each quadrature of the tachometer assembly. During the first 5 seconds of the service aid, all indicators remain illuminated. Following this delay the percentage of phase shift between both tachometer inputs for quadrature 00 is displayed on the front panel indicators. Actuation of the LOAD switch will sequence to the next quadrature until all four of

the phase quadratures have been displayed. On the next LOAD switch actuation, the servo direction is reversed and the previous sequence repeated. See Figure 3-2. A display count of 8 represents the nominal phase shift of about 90 degrees. The minimum phase shift allowable is 30 degrees, or a binary count of 3.

3-12. Service Aid 21. In this service aid hardware ports ONL and RWD are toggled with interrupts disabled for repeatable triggering. The on-line status latch and rewind status latch are pulsed in sequence. Next, the read formatter enables and the six output status ports are toggled in binary sequence. After a 10-millisecond delay, the entire sequence is repeated. The lines are toggled in binary sequence to allow quick, shorted-line detection, and to provide easily recognizable patterns for troubleshooting.

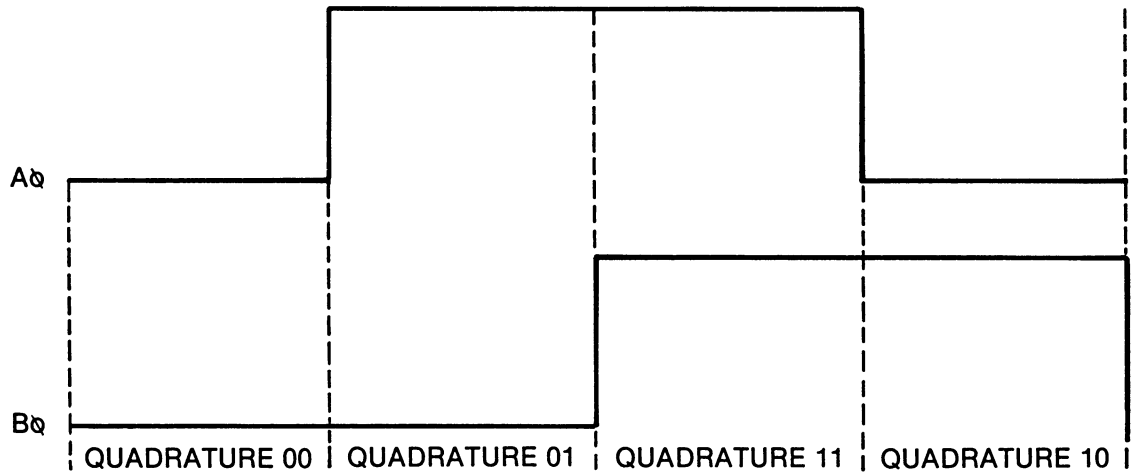

Figure 3-2. Tachometer Phase Quadrature

3-13. Service Aid 22. This service aid is used to display the output voltage of the BOT sensor via the front panel indicators. The value is periodically updated to allow insertion of a small piece of half-inch tape with a BOT reflective marker so that voltage levels produced from blank tape and BOT marker can be checked. To avoid erroneous indications, it may be necessary to shield the EOT/BOT sensor from ambient light. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.16) = Output Voltage

3-14. Service Aid 23. This service aid is identical to Service Aid 22, except that the EOT circuit is activated.

3-15. Service Aid 24. This service aid measures the tension arm transducer voltage and displays the value as two 4-bit nibbles. The low-order bits (0 - 3) are displayed when the HI DEN indicator is not illuminated, and the high-order bits (4 - 7) are displayed when the HI DEN indicator is illuminated. The normal indicated range should be between negative 0.46 volt and positive 4.10 volts. Actuation of the LOAD switch will sequence the display from the low-order bits to the high-order bits. Refer to Table 3-1. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.04) = Transducer Voltage

BITS	BITS	VOLTAGE
7 6 5 4	3 2 1 0	
0 1 1 1	1 1 1 1	+4.96
0 1 1 1	1 1 1 0	+4.92
0 1 1 1	1 1 0 1	+4.88
. . . .	. . . .	....
. . . .	. . . .	....
0 0 0 0	0 0 0 1	+0.04
0 0 0 0	0 0 0 0	0.00
1 1 1 1	1 1 1 1	-0.04
. . . .	. . . .	....
. . . .	. . . .	....
1 0 0 0	0 0 1 0	-4.92
1 0 0 0	0 0 0 1	-4.96
1 0 0 0	0 0 0 0	-5.00

Table 3-1. Compliance Arm Voltage Display

3-16. Service Aid 24 can also be used to display the absolute output of the compliance arm. To measure the voltage delta, actuate the UNLOAD switch while positioning the compliance arm against the forward stop. The binary output can be converted to an analog value by the following equation:

(Binary Count) X (0.04) = Voltage Delta

3-17. Service Aid 31. Only the supply servo is enabled in this service aid. Its purpose is to check the file-protect/reel-seat sensor and the tape-in-path sensor. To check the file-protect sensor, remove the write-enable ring from a reel of tape and place the tape on the supply hub. As the supply hub slowly rotates in a counterclockwise direction, a quick double pulse of the UNLOAD indicator should occur, which can only be observed by grasping and slowly rotating the supply hub until the reel-seat reflector moves past the sensor. With the write-enable ring installed, a single pulse of the UNLOAD indicator should also be observed as the file-protect tab rotates past the sensor. The LOAD indicator should initially be illuminated, indicating no tape in path. To check the sensor, insert a piece of half-inch tape so that it blocks the tape-in-path sensor and extinguishes the LOAD indicator.

3-18. Service Aid 32. This service aid rotates the supply servo counterclockwise while activating the hub lock solenoid. The hub should come to a stop when the hub tab engages the bellcrank. The reel servo is momentarily reversed and the hub lock solenoid disengaged. The hub is then positioned past the solenoid latch before it is reactivated and the cycle repeated. During this service aid, the door interlocks are also cycled. If both top cover and front panel doors are not closed, the ON-LINE indicator will illuminate.

CAUTION

This service aid is intended for use by skilled technicians only. Repeated activation of this service aid could damage door interlocks.

3-19. Service Aid 33. This service aid disables both top-cover and front panel door interlocks to allow observation of the tape path during operation. Door interlocks are reactivated when tape is unloaded following completion a load sequence or when transport power is turned off.

3-20. Service Aid 34. During this service aid, the LOAD switch controls the blower motor. When the LOAD indicator is illuminated, the blower motor should be activated.

3-21. **Diagnostic Mode (Tape Loaded).** Diagnostic mode service aids with tape in the transport are described in the following subparagraphs.

3-22. Service Aid 11. This service aid injects a 0.2-volt (peak-to-peak) 500 kHz, triangle wave (RNOISE) into the read amplifier circuits. This service aid may also be activated by the controller. Select this service aid only during 1600 bpi operation. If this service aid is selected during 3200 bpi operation, Hard Errors will result.

3-23. Service Aid 12. This service aid disables Service Aid 11.

3-24. Service Aid 13. Approximately + 0.25-volt of ripple is injected into the +5 VCC circuits. This service aid provides additional margin checking when combined with Service Aid 11 and activated during systems diagnostic operation.

3-25. Service Aid 14. This service aid disables Service Aid 13.

NOTE

Both Service Aids 11 and 13 are deactivated during tape unload and whenever the power-up sequence is initiated. This prevents inadvertent use of either service aid during normal operation.

3-26. Service Aid 21. This service aid allows adjustment of the read threshold circuit by utilizing the LOAD and UNLOAD indicators. Refer to paragraph 4-16.

3-27. Service Aid 22. During this service aid, the drive cycles tape in both forward and reverse directions while alternating speed between 25 and 100 ips. The front panel displays the maximum tension arm motion sensed before an arm fault would occur.

3-28. Service Aid 23. This service aid can be used to write data blocks at either 25 ips (LOAD switch activated) or 100 ips (UNLOAD switch activated). Last word (ILWD) must be grounded to generate a one-character data block complete with postamble. If ILWD is not grounded, a HER and a CER status will occur. If the reel of tape loaded on the transport does not have a write enable ring installed, only the data previously written on the tape will be read. The 3200 bpi MTSU has the additional capability of writing and reading at 3200 bpi (50 ips) by pressing the LOAD or UNLOAD switch

following selection of Service Aid 23 with the transport operating in the HI DEN mode. Both models will perform a read reverse operation during Service Aid 23 if the HI DEN switch is depressed while selecting the desired operating speed.

NOTE

When operating the MTSU in a multiple transport (daisy chain) configuration it is recommended that the system software be halted during execution of the following Service Aids: Service Aid 12, 13, and 21 with no tape loaded; Service Aid 21 and 23 with tape loaded.

TRANSPORT ERROR CONDITIONS

3-29. Abnormal conditions are indicated by various front panel display patterns. These error codes are also displayed as binary-coded patterns.

3-30. **Transport Error Codes.** These codes indicate a serious deviation from the normal operating routine of the MTSU. Each error code is represented as a unique binary pattern of the front panel indicators which flash a quick double-pulse to alert the operator.

3-31. Table 3-2 identifies each error code and describes briefly the conditions which may have caused the failure. Before normal operation is attempted, transport power must be turned off to reset the error. If the error code is repeated, refer to paragraph 3-32 for troubleshooting instructions.

BINARY CODE	INDICATION	CONDITIONS
3	LOAD and UNLOAD indicators flashing	The MTSU detected more than 3700 feet of tape beyond the BOT marker.
4	ON-LINE indicator flashing	The tension arm swing exceeded the range of normal operation during the auto load sequence.
5	LOAD and ON-LINE indicators flashing	The MTSU received an interface command prior to completion of the previous command.
6	UNLOAD and ON-LINE indicators flashing	The MTSU received a write command with a write-protected reel of tape loaded on the transport.
7	LOAD, UNLOAD, and ON-LINE indicators flashing	An illegal or undefined command was received by the MTSU.
8	TEST indicator flashing	A failure of the supply hub locking mechanism occurred.
9	NOT USED	-
10	UNLOAD and TEST indicators flashing	The auto-zero function of the digital-to-analog converter failed during the power-up sequence.
12	ON-LINE and TEST indicators flashing	Supply reel was not seated on hub, or a failure of the file protect circuit occurred.
13	LOAD, ON-LINE, and TEST indicators flashing	Supply reel did not remain locked during tape unload operation.
14	TEST, UNLOAD, and ON-LINE indicators flashing	Because of a controller error, tape travel beyond the EOT marker exceeded 18 feet.
17	LOAD and HI DEN indicator flashing	The tape buffer tension arm exceeded its free travel limits during any operation except those functions of the load and unload sequence where tape tension is not under arm control.
18	UNLOAD and HI DEN indicator flashing	Tape speed variations in excess of the ANSI maximum of ±10% deviation from normal operation speed occurred.

Table 3-2. System Fault Codes

TROUBLESHOOTING

3-32. Before performing any troubleshooting operation, the technician must have a good understanding of the theory of operation of the transport and any associated equipment. He should check carefully to ensure that all equipment is connected properly and that all associated equipment is in good operating condition. He should be thoroughly familiar with operating instructions and follow them carefully in performing the troubleshooting procedure.

3-33. To enable the maintenance technician to isolate malfunctions within the Magnetic Tape Streamer Unit (MTSU), the Troubleshooting Test Procedures (TTP) contain a recommended sequence to troubleshoot each malfunction. Erroneous failure symptoms may be caused by failures in the microprocessor circuitry. If a definite failure is not established upon completion of a specific TTP, use the TTP power-up failure (PF1000) to troubleshoot the microprocessor circuitry. Tables 3-3, 3-4, 3-5, and 3-6 list common symptoms associated with operation of a MTSU together with the probable cause and remedial action required to correct each failure. Table 3-7 can be used to find the test points specified in the TTPs.

3-34. Table 3-3 contains malfunction symptoms the MTSU may exhibit following a power-up failure.

3-35. Table 3-4 contains the malfunction symptoms the MTSU may exhibit if a failure occurs in the auto load sequence. Each malfunction will produce a fault code which displays itself as a steady flashing pattern ("on" then "off") on the respective front-panel indicators.

3-36. Table 3-5 contains the malfunction symptoms the MTSU may exhibit if a serious deviation takes place from the normal operating routine within the MTSU. Each symptom will be shown as a unique binary pattern on the front-panel indicators.

3-37. Table 3-6 contains the malfunction symptoms the MTSU may exhibit if a failure occurs outside the internal diagnostic circuits of the MTSU and cannot be detected.

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Failure to complete power-up sequence. Transport unable to initiate any local or remote commands.	During power-up operation, all indicator lights on front panel illuminate for approximately one second. If all indicators extinguish except UNLOAD, no defect is indicated.	Refer to power-up failure TTP PF1000.
	Any invalid fault code also indicates failure. If the fan begins operating at power-up, a failure is also indicated.	Refer to TTP PF1000.

Table 3-3. Power-Up Malfunction Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
All indicators flashing	1. After four automatic retries, transport cannot successfully complete load sequence. 2. Tape leader may be excessively damaged.	Refer to TTP LD1000. Remove damaged tape leader and replace BOT.
All indicators except LOAD flashing	BOT marker was not detected within first 35 feet of tape.	Check tape for BOT marker. Use Service Aid 22 to check BOT sensor. Refer to TTP BE1000.
All indicators except UNLOAD flashing	1. Tape reel inserted upside-down. 2. Tape-in-path sensor failed.	Insert reel correctly. Use Service Aid 31 to check tape path sensor. Refer to TTP HS1000.
All indicators except ON-LINE flashing	Load operation attempted with front panel door or top cover in open position.	Use Service Aid 32 to check door lock. Refer to TTP HD1000.
All indicators except TEST flashing	Load operation attempted without reel of tape inserted in unit.	1. Open top cover; verify reel is seated on supply hub. If not, retry load operation. During load operation, verify supply servo rotates in counterclockwise direction. Use Service Aid 11 to check supply servo. Refer to TTP SE1000. 2. If reel is seated and supply hub is rotating counterclockwise, use Service Aid 31 to check reel seat sensor. Refer to TTP HS1000.

Table 3-4. Operator Error Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
LOAD and UNLOAD indicators flashing	MTSU detected more than 3700 feet of tape beyond BOT marker.	1. Usually caused by long reel of tape. Try different reel of tape. 2. Use Service Aid 14 to check tachometer position logic. Refer to TTP TA1000.
ON-LINE indicator flashing	Tension arm swing exceeded range of normal operation during load sequence.	1. Only occurs during load operation. Open top cover; verify tape is properly wrapped around takeup hub. If so, check compliance arm using Service Aid 24. Refer to TTP CA1000. 2. If tape is not wrapped around takeup hub, refer to TTP LD1000.
LOAD and ON-LINE indicators flashing	MTSU received interface command prior to completion of previous command. IGO should not go true until IDBSY goes false.	1. Usually caused by system failure. 2. Use Service Aid 21 to check interface signal IDBSY. Refer to TTP TI1000.
UNLOAD and ON-LINE indicators flashing	MTSU received write command with write-protected reel of tape loaded on MTSU.	1. Reset error code and reload tape. If WRT/EN indicator is extinguished, use Service Aid 31 to check file protect sensor. Refer to TTP HS1000. 2. If WRT/EN indicator is illuminated, use Service Aid 21 to check interface line to controller. Refer to TTP TI1000.

Table 3-5. Transport Failure Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
LOAD, UNLOAD, and ON-LINE indicators flashing.	Illegal or undefined command was received by MTSU.	1. Check cables and interface command lines to MTSU. 2. Refer to TTP CL1000.
TEST indicator flashing	Failure of supply hub lock mechanism occurred.	1. Failure only occurs during load sequence. If reel appeared to lock correctly, use Service Aid 11 to check D to A converter. Refer to TTP SE1000. 2. Use Service Aid 32 to check hub lock solenoid. Refer to TTP HD1000.
UNLOAD and TEST indicators flashing	Auto-zero function of D to A converter failure during power-up sequence.	To bypass this error, switch MTSU power ON while pressing the TEST switch. Select Service Aid 11 to check D to A converter. Refer to TTP SE1000.
ON-LINE and TEST indicators flashing	Supply reel was not seated on hub, or failure of the file protect circuit occurred.	1. Manually seat reel on hub and load the tape. 2. Use Service Aid 31 to check the reel seat/file-protect circuit. Refer to MTP HS1000.
LOAD, ON-LINE and TEST indicators flashing.	Supply reel did not remain locked during tape unload operation.	1. If last command sent to the transport was an unload command, use Tests 22 and 23 to verify EOT/BOT sensors are working properly. Refer to MTP BE1000.

Table 3-5. Transport Failure Symptoms (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
UNLOAD, ON-LINE, and TEST indicators flashing.	Because of controller error, tape travel beyond EOT marker exceeded 18 feet.	Use Service Aid 21 to check IEOT interface line. Refer to TTP T11000.
LOAD and HI DEN indicators flashing	The servo tension arm has exceeded its free travel limits during any operation except those functions of the load and unload sequence where tape tension is not under arm control.	1. If the MTSU missed the BOT or EOT marker and caused tape to run off reel, refer to TTP BE1000. 2. Use Service Aid 24 to check compliance arm. 3. Use Service Aid 11 to check servos and D to A converter. Refer to TTP SE1000.
UNLOAD and HI DEN indicators flashing	Tape speed variations occurred in excess of ANSI maximum of ±10% deviation from normal operating speed. Problem usually caused by bad tachometer assembly when drive is under system operation. A tachometer test is performed as part of the power-up diagnostic routine and may be bypassed to allow access to other diagnostic tests by depressing the TEST switch for 5 seconds during powerup.	1. If failure occurs during powerup, check that takeup hub moves momentarily counterclockwise then clockwise during powerup. If not, use Service Aid 11 to check the takeup servo. Refer to TTP SE1000. 2. Use Service Aid 14 to check tachometer. Refer to TTP TA1000.

Table 3-5. Transport Failure Symptoms (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Read or write errors during system operation	System is unable to complete data transfer.	1. To determine if errors are caused by read or write logic, try to read a known good tape. If errors still occur, troubleshoot read formatter. Refer to TTP RF1000. 2. If the tape is read successfully, problem is in write formatter circuitry. Use Service Aid 12 to check formatter. Refer to TTP WR1000.
Tape reel cannot be removed from transport	Tape not wound completely on supply reel or tape reel.	1. Following an unload operation, ensure that tape is wound completely on supply reel. Use Service Aid 22 to check EOT/BOT sensors. Refer to TTP BE1000. 2. If tape is completely wound on supply reel, the tape reel should be unlocked. Use Service Aid 32 to check hub lock. Refer to TTP HD1000. 3. Use Service Aid 11 to check takeup servo circuit. Refer to TTP SE1000.
MTSU "runs away" with Data Busy false	Transport formatter no longer controlling tape motion.	Use Service Aid 14 to check tachometer. Refer to TTP TA1000.

Table 3-6. System Failure Symptoms

SYMPTOM	PROBABLE CAUSE	REMEDIAL ACTION
Transport "runs away" with Data Busy true	Transport formatter no longer controlling tape motion.	1. First, check read threshold and verify that it is in proper operating range. If transport was executing read operation when runaway occurred, check read formatter. Use Service Aid 23 to check read formatter. Refer to TTP RF1000. 2. If transport was executing write operation, use Service Aid 12 to check write formatter. Refer to TTP WR1000.
Doors will not lock or unlock. Operator unable to insert tape into transport.	Door lock malfunctioning.	Use Service Aid 32 to check door lock. Refer to TTP HD1000.
When drive is placed ON-LINE, tape unloads.	Transport will not operate in on-line mode.	Disconnect cables between transport and computer. If a problem still exists, transport is at fault. Refer to TTP LD1000.
System detects one or more of the following interface signals are not valid: IFBY, IRDY, IDBSY, IFPT, ILDP, IEOT, IONL, IRWD, or ISPEED	System unable to verify correct transport status.	Refer to TTP TI1000 to check interface signals.
Transport ignores all commands sent by the controller, or transport executes a command other than the command issued by the controller.	System unable to initiate any remote command.	Check interface cable connection between drive and controller. Check command lines. Refer to TTP CL1000.
System is unable to select transport.	Invalid status indications from transport to controller.	Check interface cable connection to transport. Refer to drive selection TTP DS1000.

Table 3-6. System Failure Symptoms (Continued)

3-38. **Power Control and System Failure Detect TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the power control and system failure detect logic circuits.

STATEMENT NUMBER	
PF1000	During power-up operation all indicator lights on the front panel are illuminated for approximately one second. If all indicators remain extinguished except UNLOAD following this period of time, no defect is indicated. A failure to properly complete the power-up sequence will be indicated by one of the following error indications: a. If all front panel indicators remain illuminated following actuation of the POWER switch, refer to TTP PF1010. b. Following actuation of the POWER switch, if all indicators are illuminated for approximately one second, then briefly extinguished, then illuminated continuously, refer to TTP PF1130. c. If any invalid fault code is displayed by the front panel indicators during power-up operation, refer to TTP PF1010.
PF1010	Is the signal at TP 89 a +5.0 ±0.25Vdc level? YES = PF1020 NO = PF1030
PF1020	Is the signal at TP 63 at a +5.0 ±0.25Vdc level? YES = PF1080 NO = PF1060
PF1030	Is P3-6 at a +10.0 ±2.0Vdc level? YES = PF1040 NO = PF1050
PF1040	Problem is Q7. When replaced and the signal at TP 89 is at +5.0Vdc level, refer to TTP PF1000.
PF1050	Problem is on the power supply board or a bad cable connection. When repaired, refer to TTP PF1000.
PF1060	Is P3 pin 4 at a +24.0 ±5Vdc level? YES = PF1070 NO = PF1050
PF1070	Problem is Q20. When replaced and the signal at TP 63 is at +5.0 ±0.25Vdc level, refer to TTP PF1000.
PF1080	Is U3L-9 high? YES = PF1090 NO = PF1100

STATEMENT NUMBER	
PF1090	Problem is U1K or supporting components. When repaired, refer to TTP PF1000.
PF1100	Switch MTSU power off. Using a jumper, ground U3L-8. Also remove U10L from its socket. Switch MTSU power on. Does the system fail indicator (DS1) remain illuminated? YES = PF1110 NO = PF1120
PF1110	Problem is U1K, U3L, Q17, or K1. Remove ground wire and reinstall U10L. If MTSU still does not power up successfully, refer to TTP PF1100.
PF1120	Problem is U2K, U1H, or U10L. Remove ground wire and reinstall U10L. When repaired, refer to TTP PF1130.
PF1130	The following steps are used to troubleshoot the system clock. Is U6L-6 a 2.0 ±0.01MHz clock? YES = PF1170 NO = PF1140
PF1140	Is the signal at TP 62 an 8.0 ±0.01 MHz clock? YES = PF1160 NO = PF1150
PF1150	Problem is Y1, U8R, U8P, or supporting components. When repaired and the signal at TP 62 is an 8MHz clock, refer to TTP PF1000.
PF1160	Problem is U8P or U8R. When repaired, refer to TTP PF1000.
PF1170	The following steps will verify all necessary voltages are applied to the board. Is the signal at TP 92 at a +12 ±0.6Vdc level? YES = PF1190 NO = PF1180
PF1180	Problem is VR2. When repaired and the signal at TP 92 is at a +12.0Vdc level, refer to TTP PF1000.
PF1190	Is the signal at TP 63 at a +5.0 ±0.25Vdc level? YES = PF1210 NO = PF1200
PF1200	Problem is Q20. When repaired and the signal at TP 63 is correct, refer to TTP PF1000.
PF1210	Is the signal at TP 90 at a -12 ±0.6Vdc level? YES = PF1230 NO = PF1220

STATEMENT NUMBER	
PF1220	Problem is VR1, cable connection or power supply. When repaired, refer to TTP PF1000.
PF1230	Is U3B-7 at a -5.0 ±0.25Vdc level? YES = PF1250 NO = PF1240
PF1240	Problem is C162, C4, or R352. When repaired, refer to TTP PF1000.
PF1250	Is the signal at TP 89 at a +5.0 ±0.25Vdc level? YES = PF1265 NO = PF1260
PF1260	Problem is Q7, the cable connection, or with the power supply board. When repaired, refer to TTP PF1000.
PF1265	Switch MTSU power off. Using a jumper wire, ground pins 1 and 4 of U17N. Does the drive now power up correctly? YES = PF1266 NO = Remove ground wire. Refer to TTP PF1270
PF1266	The microprocessor is failing due to excessive interrupts from the tachometer circuitry. Go to TA1000 and troubleshoot the tachometer, keeping in mind that U17N pins 1 and 4 are grounded.
PF1270	The power-up failure has now been narrowed down to the microprocesor logic. Due to the complexity in troubleshooting this area, first replace the following socketed IC's one at a time. Switch MTSU power off when replacing an IC. U6P, U7P, U6N, U8N, U10N, U12N, U6L, U14N, U8L, U10L, U12L, and U14L. If failure still exists, go to PF1280.
PF1280	Replace the following: U8R, U9P, U10P, U7H, U5F, U3N, U3L, or U4R. If failure is still present, we are unable to determine the cause.

3-39. **Auto-Load Sequence TTP.** This TTP describes the diagnostic steps required to isolate a failure during the auto-load sequence (Service Aid 33).

STATEMENT NUMBER		
LD1000	Activate Service Aid 33 to allow observation of the tape path area and initiate the load sequence by pressing the LOAD switch. Does the supply hub slowly rotate counterclockwise? YES = LD1010	NO = SE1000
LD1010	Is the supply reel seated properly on the supply hub? If it is not, all indicators will flash except the TEST indicator. YES = LD1020	NO = HS1000
LD1020	Does the blower motor begin operation? YES = LD1030	NO = BL1000
LD1030	Does the MTSU lock the reel onto the supply hub? YES = LD1040	NO = HD1000
LD1040	Does the supply servo perform a high speed spin for a short time to determine reel size? YES = LD1050	NO = SE1000
LD1050	The supply servo should slowly turn counterclockwise until the end of tape is stripped off the reel and breaks the path of the tape-in-path sensor. The supply servo continues to turn counterclockwise until the tape is withdrawn and reenters a second time from the tape path, then the supply servo starts rotating in the clockwise direction, feeding tape in the column. Does this happen? YES = LD1060	NO = SE1000 or HS1000.
LD1060	Does the tape continue past the EOT/BOT sensors and toward the takeup hub? If the EOT/BOT sensors fail to detect the tape go by within three seconds from the time TIP sensor was tripped, the MTSU will rewind the tape back on the supply hub and automatically retry the load sequence. YES = BE1000	NO = LD1065
LD1065	Is the takeup servo rotating in the clockwise direction? YES = LD1070	NO = SE1000

STATEMENT NUMBER	
LD1070	The tachometer should sense a decrease in speed as the tape wraps around the takeup hub. Once the tape is wrapped securely around the takeup hub both the takeup and supply servos should come to a stop. Do they? YES = LD1090 NO = LD1080
LD1080	Observing the takeup servo, which of the following best describes the failure symptom? a. Tape wraps around the takeup reel but the servo doesn't try to come to a stop and after four or five seconds the tape is rewound on the supply reel. If so, first clean the takeup hub and verify the tape isn't slipping on the hub. If the problem still occurs refer to TTP TA1000. b. The takeup servo is very unstable; possibly even changing directions and a fault code 4 or 18 occurs. Refer to TTP TA1000. c. The takeup hub starts turning in the counterclockwise direction and the MTSU displays fault code 4. Refer to TTP SE1000.
LD1090	Next the MTSU will calibrate the compliance arm. If an error is found the MTSU will display fault code 4. Does the MTSU calibrate the arm successfully? YES = LD1100 NO = CA1000
LD1100	The MTSU should move tape forward at 25 ips while looking for the BOT marker and determine if the tape reel has a write-enable ring. If the write-enable ring is present the WRTEN/TEST indicator should illuminate. Does it? YES = LD1110 NO = HS1000
LD1110	Does the tape stop with the LOAD indicator illuminated at the BOT marker? YES = LD1120 NO = BE1000
LD1120	Press the ON-LINE switch. Does the ON-LINE indicator illuminate? YES = LD1130 NO = LD1140
LD1130	The LOAD sequence is now complete and the MTSU is ready for system operation.
LD1140	Is the MTSU still at BOT? YES = LD1150 NO = LD1160

STATEMENT NUMBER	
LD1150	Problem is U17L, U10L, the switch panel or a bad cable connection between the switch and the formatter PWB. When repaired, refer to TTP LD1000.
LD1160	Is U3V-1 low? YES = LD1180 NO = LD1170
LD1170	Troubleshoot the IONL and IRWD interface lines using Service Aid 21. Refer to TTP TI1000.
LD1180	Is the interface signal IRWU at U4W-9 low? YES = LD1190 NO = LD1200
LD1190	Problem is U4W, U10W, or the controller is holding the interface line low. When repaired, refer to TTP LD1000.
LD1200	Problem is U4W, U4V, U5V, or U3V. When repaired, refer to TTP LD1000.

3-40. **Takeup and Supply Servo TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the takeup and supply servo circuits (Service Aid 11).

STATEMENT NUMBER	
SE1000	Select Service Aid 11 and visually inspect the drive. Which of the following best describes the observed malfunction, if any? a. Neither one of the servos is working correctly. Refer to TTP SE1010. b. Takeup servo is working; however, the supply servo is not. Refer to TTP SE1290. c. Supply servo is working; however, the takeup servo is not. Refer to TTP SE1130. d. Both servos appear to be working properly. Refer to TTP SE1460. e. If directed to check out the D to A from another section, refer to TTP SE1010.
SE1010	The following will check out the D to A circuitry. Is the signal VOUTØ (U3M-8) at a +0.75 ±0.2Vdc level? YES = SE1020 NO = SE1080

STATEMENT NUMBER	
SE1020	Is the signal VOUT1 (U3M-1) at a -0.7 ±0.1Vdc level? YES = SE1030 NO = SE1080
SE1030	Is the signal VOUT2 (U3M-14) switching between +2.0Vdc and -2.0Vdc ±0.2Vdc? YES = SE1040 NO = SE1080
SE1040	Is the signal VOUT3 (U3M-7) at a +0.5 ±0.1Vdc level? YES = SE1050 NO = SE1080
SE1050	Is the signal VOUT4 (U2M-7) switching between +2.0Vdc and -2.0Vdc ±0.2Vdc? YES = SE1060 NO = SE1080
SE1060	Is the signal VOUT5 (U2M-1) at a +0.5 ±0.1Vdc level? YES = SE1062 NO = SE1080
SE1062	Switch MTSU power off. Check U5E-4 during the power-up sequence while all front-panel indicators are illuminated. Does U5E-4 go to a +5.3 ±0.3Vdc level? YES = SE1066 NO = SE1064
SE1064	Problem is U5E or U2N. When repaired, refer to TTP SE1000.
SE1066	During the power-up sequence and while all front panel indicators are off, U5E-4 should go to ground, leveling off somewhere between +5.0Vdc and -5.0Vdc, then the UNLOAD indicator should illuminate. Which of the following best describes the signal on U5E-4: a. The signal stays at +5.3 ±0.3Vdc and the MTSU fails with fault code 10. Refer to TTP SE1064. b. The signal goes to zero volts ±0.5Vdc and the MTSU fails with fault code 10. Refer to TTP SE1068. c. The signal goes to zero volts, slowly moves to either +5.0Vdc or -5.0Vdc, then goes to +5.0 ±0.3Vdc and the drive fails with fault code 10. Refer to TTP SE1068. d. The drive powers up correctly as described. Refer to TTP SE1070.

STATEMENT NUMBER	
SE1068	Perform the test starting at SE1460. If, after replacing the IC's called out in statement number SE1780, the drive still fails with fault code 10, replace U5E and U2N. If a problem is found before reaching TTP SE1780, follow the instructions described in the statement.
SE1070	Reselect Service Aid 11. Do both servos appear to be operating correctly? YES = SE1460 NO = SE1130
SE1080	Is the signal at TP 60 toggling? YES = SE1090 NO = SE1100
SE1090	Replace U2N, U2M, U3N, and U3M. If the signal is still bad, problem is the destination IC. If troubleshooting VOUT1, replace U5E. If troubleshooting VOUT2, replace U4B. If troubleshooting VOUT3, replace U3D. If troubleshooting VOUT4, replace U3B. If troubleshooting VOUT5, replace U3A. When repaired, refer to TTP SE1000.
SE1100	Are the signals IOREQ* (U3L-3) and WR*(U4P-10) toggling? YES = SE1110 NO = SE1120
SE1110	Problem is U3L, U4N, U4P, or U4R. When repaired and the signal at TP 60 is toggling, refer to TTP SE1000.
SE1120	Problem is the Z80 microprocessor, U6L, or the test wasn't selected correctly. When resolved, refer to TTP SE1000.
SE1130	The following will check out the takeup servo circuitry. Is the signal at TP 14 switching between +10Vdc and -10 ±2Vdc? YES = SE1140 NO = SE1145
SE1140	Problem is a bad cable connection or a bad takeup motor. When problem is repaired and takeup servo is working correctly, refer to TTP SE1000.
SE1145	Check signals VOUT4 and VOUT5 by performing TTP SE1050 and SE1060. If the answer to both steps is YES, refer to TTP SE1150. If the answer to either one of the steps is NO, refer to the TTP it describes.

STATEMENT NUMBER		
SE1150	Is the signal P2A3 (U3B-11) low?	
	YES = SE1170	NO = SE1160
SE1160	Problem is U12L. When repaired, refer to TTP SE1000.	
SE1170	Is the signal at TP 61 at a -35.0 ±6.0Vdc level?	
	YES = SE1220	NO = SE1180
SE1180	Is P3 pin 8 at a -35.0 ±6.0Vdc level?	
	YES = SE1200	NO = SE1190
SE1190	Problem is the cable connection to the power supply or a failure in the power supply. When repaired and P3 pin 8 is at -35.0 ±6.0Vdc, refer to TTP SE1000.	
SE1200	Is the signal P2B3 (U12L-30) low?	
	YES = SE1210	NO = SE1160
SE1210	Problem is Q21, Q22, or Q5. When repaired and TP 61 is correct, refer to TTP SE1000.	
SE1220	Is the signal at TP 6 switching between +9.0Vdc and -9.0 ±2.0Vdc?	
	YES = SE1230	NO = SE1240
SE1230	Problem is U3B or one of the following transistors Q1, Q2, Q8, Q9, Q10, or Q11. When repaired, refer to TTP SE1000.	
SE1240	Is the signal at TP 22 at a -0.5Vdc level?	
	YES = SE1260	NO = SE1250
SE1250	Problem is U3A, R21, R20, CR1, or CR2. When repaired and the signal at TP 22 is at a -0.5Vdc level, refer to TTP SE1000.	
SE1260	Does TP 16 go to a +10.0 ±2Vdc level for 80 ±40 milliseconds when the takeup hub starts to rotate clockwise and a -10.0 ±2Vdc level for 80 ±40 milliseconds when the servo starts to rotate counterclockwise?	
	YES = SE1270	NO = SE1280
SE1270	Problem is U3A, R18, or R19. When repaired and TP 6 is correct, refer to TTP SE1000.	

STATEMENT NUMBER		
SE1280	Problem is U3A, U3B, or supporting components. When repaired, refer to TTP SE1000.	
SE1290	The following will check out the supply servo circuitry. Is the signal at TP 13 switching between +10.0Vdc and -10.0 ±2.0Vdc?	
	YES = SE1300	NO = SE1310
SE1300	Problem is a bad cable connection to the servo circuit or a bad supply servo. When problem is repaired and supply servo is working correctly, refer to TTP SE1000.	
SE1310	Check signals VOUT2 and VOUT3 by performing TTP SE1030 and SE1040. If the answer to both steps is YES, refer to TTP SE1320. If the answer to either one of the steps is NO refer to the TTP it describes.	
SE1320	Is the signal P2A3 (U3B-10) low?	
	YES = SE1330	NO = SE1160
SE1330	Is TP Ø at a +35.0 ±6Vdc level?	
	YES = SE1380	NO = SE1340
SE1340	Is P3 pin 10 at a +35.0 ±6Vdc level?	
	YES = SE1360	NO = SE1350
SE1350	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 10 is at +35.0 ±6Vdc, refer to TTP SE1000.	
SE1360	Is the signal P2B2 (U12L-29) high?	
	YES = SE1370	NO = SE1160
SE1370	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1000.	
SE1380	Is the signal at TP 12 switching between +9.0Vdc and -9.0 ±2.0Vdc?	
	YES = SE1390	NO = SE1400
SE1390	Problem is U3B or one of the following transistors: Q3, Q4, Q12, Q13, Q14, or Q15. When repaired, refer to TTP SE1000.	
SE1400	Is the signal at TP 24 at a -0.5 ±0.2Vdc level?	
	YES = SE1420	NO = SE1410

STATEMENT NUMBER	
SE1410	Problem is U3D, R71, R72, CR5, or CR6. When repaired and TP 24 is at a -0.5Vdc level, refer to TTP SE1000.
SE1420	Does TP 25 go to a +10.0 ±2.0Vdc level for 80 ±40 milliseconds when the takeup starts to rotate in the clockwise direction and a -10.0 ±2.0Vdc level for 80 ±40 milliseconds when the servo starts to rotate in the counterclockwise direction? YES = SE1430 NO = SE1440
SE1430	Problem is with U3A, R47, or R48. When repaired and TP 12 is correct, refer to TTP SE1000.
SE1440	Are signals P2A4 (U4B-11) and P2A5 (U4B-10) both high? YES = SE1450 NO = SE1460
SE1450	Problem is U4B or U3D. When repaired and TP 25 is correct, refer to TTP SE1000.
SE1460	The following will check out the inputs to the A to D converter. Is U2R-12 at a -3.0 ±0.5Vdc when the servos are rotating clockwise and at a +3.0 ±1.0 Vdc level when rotating counterclockwise? YES = SE1480 NO = SE1470
SE1470	Problem is U3E or U3D. When repaired and U2R-12 is correct, refer to TTP SE1480.
SE1480	Is U2R-1 at a -2.0 ±0.2Vdc level when the servos are rotating clockwise and at a +2.0 ±0.2Vdc level when rotating counterclockwise? YES = SE1500 NO = SE1490
SE1490	Problem is U3E or U3D. When repaired and U2R-1 is correct, refer to TTP SE1500.
SE1500	Is U2R-5 going to a -1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servos start to rotate in the clockwise direction and at a +1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servo starts to rotate counterclockwise? YES = SE1520 NO = SE1510
SE1510	Problem is R337, or C171; When repaired, refer to TTP SE1520.

STATEMENT NUMBER	
SE1520	Is U2R-2 going to a +1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servos start to rotate in the clockwise direction and at a -1.0 ±0.1Vdc level for 100 ±40 milliseconds when the servo starts to rotate counterclockwise? YES = SE1540 NO = SE1530
SE1530	Problem is U3E or U3D. When repaired and U2R-2 is correct, refer to TTP SE1540.
SE1540	Is U2R-4 at a +2.5 ±0.5Vdc level when the servos are rotating clockwise and at a -2.0 ±0.5Vdc level when rotating counterclockwise? YES = SE1560 NO = SE1550
SE1550	Problem is U3B, R341, or C165. When repaired and U2R-4 is correct, refer to TTP SE1560.
SE1560	Is the signal at TP 61 a -35 ±6.0Vdc level? YES = SE1620 NO = SE1570
SE1570	Is P3 pin 8 at a -35 ±6.0Vdc level? YES = SE1590 NO = SE1580
SE1580	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 8 is at a -35.0 ±6.0Vdc level, refer to TTP SE1000.
SE1590	Is the signal P2B3 (U12L-30) low? YES = SE1610 NO = SE1600
SE1600	Problem is U12L. When repaired, refer to TTP SE1000.
SE1610	Problem is Q21, Q22, or Q5. When repaired and TP 61 is correct, refer to TTP SE1000.
SE1620	Is the signal at TP Ø a +35.0 ±6.0Vdc level? YES = SE1670 NO = SE1630
SE1630	Is P3 pin 10 at a -35.0 ±6.0Vdc level? YES = SE1650 NO = SE1640
SE1640	Problem is the cable connection to the power supply or the power supply circuit. When repaired and P3 pin 10 is at a +35.0 ±6.0Vdc level, refer to TTP SE1000.

STATEMENT NUMBER		
SE1650	Is the signal P2B2 (U12L-29) high?	
	YES = SE1660	NO = SE1600
SE1660	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1000.	
SE1670	Press the UNLOAD switch once. Is the signal at TP 61 -24.0 ±5.0Vdc?	
	YES = SE1700	NO = SE1680
SE1680	Is the signal P2B3 (U12L-30) high?	
	YES = SE1690	NO = SE1600
SE1690	Problem is Q21, Q22, or Q5. When repaired and the signal at TP 61 is -24.0 ±5.0Vdc, refer to TTP SE1700.	
SE1700	Is the signal at TP Ø 24.0Vdc ±5.0Vdc?	
	YES = SE1720	NO = SE1710
SE1710	Problem is Q23 or Q6. When repaired and TP Ø is correct, refer to TTP SE1720.	
SE1720	Does the signal on TP 60 go low for 4.0 ±0.2 microseconds?	
	YES = SE1770	NO = SE1730
SE1730	Does the signal on U4N-5 go high for 5.8 ±0.3 microseconds?	
	YES = SE1740	NO = SE1760
SE1740	Does the signal on U4N-4 go low for 2.0 ±1.0 microseconds?	
	YES = SE1750	NO = SE1760
SE1750	Problem is U4P or U4R. When repaired and TP 60 is correct, refer to TTP SE1000.	
SE1760	Problem is U4N, U4P, or U3L. When repaired, refer to TTP SE1720.	
SE1770	Does the signal at U4P-11 toggle?	
	YES = SE1780	NO = SE1790
SE1780	Replace U2M and U2R. If problem still exists, we are unable to determine the cause of the failure.	
SE1790	Problem is U4P, U3J, or U3L. When repaired, refer to TTP SE1000.	

3-41. **Write Formatter TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the write formatter circuitry.

STATEMENT NUMBER	
WR1000	Activate Service Aid 12 with tape unloaded. This Service Aid activates the write formatter for approximately 3 milliseconds then resets the write circuitry for approximately 1 millisecond, then repeats the sequence. When the write circuit is active, check all nine data channels to the read/write head. Verify the following locations have a 3-microsecond square-wave clock: U17J-10, U18J-10, U17J-4, U18J-4, U17J-2, U18J-12, U17J-12, U18J-2, U17J-8, U18J-8, U17J-6, U18J-6, U18K-12, U18K-2, U18K-4, U18K-6, U18K-8, and U18K-10. Which of the following best describes the failures, if any? 1. All channels are working correctly. Refer to WR1010. 2. One or more channels are dead. Refer to TTP WR1120. 3. The channels are working but are the wrong frequency. Refer to TTP WR1240.
WR1010	Press the UNLOAD switch once. Is the signal W2XCLK* (U9R-8) an 80 ±0.08kHz clock? YES = WR1020 NO = WR1060
WR1020	Is the signal WHEADCT, P6 pin 1 at +11.0 ±0.5Vdc level for +3.0 ±0.5 milliseconds? YES = WR1030 NO = WR1090
WR1030	Is the signal at U4R-1 toggling? YES = WR1040 NO = WR1310
WR1040	Does the signal at U12P-7 go high for 950.0 ±50.0 microseconds? YES = WR1050 NO = WR1280
WR1050	All signals are correct leaving the board. Check cable connections and clean read/write head. If necessary, change head assembly. If problem still exists, we are unable to identify cause of the failure.
WR1060	Is the signal POB5 (U10R-3) high? YES = WR1070 NO = WR1080
WR1070	Problem is U10R, U11R, or U14W. When repaired and U9R-8 is an 80 kHz clock, refer to TTP WR1000.

STATEMENT NUMBER	
WR1080	Problem is U8L or the UNLOAD switch wasn't pressed. When repaired and U9R-8 is an 80kHz clock, refer to TTP WR1000.
WR1090	Is the signal P0B4 (U10H-1) a clock that is low for 3.0 ±0.5 milliseconds then goes high for 2.0 ±0.5 milliseconds? YES = WR1100 NO = WR1110
WR1100	The problem is U10H, Q36, Q37, Q38, head assembly, or a bad cable connection between the PWB and the head assembly. When repaired, refer to TTP WR1000.
WR1110	Problem is U8L. When repaired, refer to TTP WR1000.
WR1120	Are the signals P2B6 (U4P-1) and P2B7 (U4V-5) both clocks that are low for 2.0 ±0.5 milliseconds then high for 3.0 ±0.5 milliseconds? YES = WR1140 NO = WR1130
WR1130	Problem is U12L or the service aid wasn't selected correctly. When repaired, refer to TTP WR1000.
WR1140	Is the signal W2XCLK* (U18L-9) a 320 ±2.0 kHz clock? YES = WR1160 NO = WR1150
WR1150	Problem is U9R, U10R, U11R, or U10P. When repaired and U18L-9 is a 320 kHz clock, refer to TTP WR1000.
WR1160	During the 3 milliseconds that the write circuitry is active, are the signals FRC1 (U15W-10), FRC2 (U15W-2), and FRC3 (U15W-12) a 3.0 ±0.5 microsecond square-wave clock? YES = WR1170 NO = WR1180
WR1170	Depending on which channel is failing (determined in TTP WR1000) check the input of the failing channel's output inverter for a 3.0 ±0.5 microsecond square-wave clock. If the signal is correct, the problem is the output inverter, cable connection, or head assembly. If signal is incorrect, problem is U17K, U18L, U14W, U15W, or U13W. When repaired, refer to TTP WR1000.
WR1180	Is the signal LASTW* (U14R-2) low? YES = WR1185 NO = WR1200
WR1185	Is the signal W2XCLK* (U12W-9) toggling? YES = WR1190 NO = WR1250

STATEMENT NUMBER	
WR1190	Problem is U12W, U14R, or the interface line P1 pin 4 is shorted to ground. When repaired, refer to TTP WR1000.
WR1200	Is the signal at U14W-2 a 3.0 ±0.5 microsecond square-wave clock? YES = WR1210 NO = WR1230
WR1210	Is the signal at U14W-1 a 3.0 ±0.5 microsecond square-wave clock for 250 ±50 microseconds while remaining high the rest of the time? YES = WR1220 NO = WR1280
WR1220	Problem is U14W, U4P, U4V, or one of the destination IC's U13W, U14W, or U15W affecting the signal. When repaired, refer to TTP WR1000.
WR1230	Problem is U12R, U14R, U14W, or U8L. When repaired, refer to TTP WR1000.
WR1240	Is the signal W2XCLK* (U9R-8) a 320.0 ±2.0kHz clock? YES = WR1160 NO = WR1250
WR1250	Is the signal at U10R-2 an 8.0 ±0.008MHz clock? YES = WR1270 NO = WR1260
WR1260	Problem is with the clock generation circuit U8R or Y1. When repaired, refer to TTP WR1000.
WR1270	Problem is U10R, U11R, U9R, or U10P. When W2XCLK* is correct, refer to TTP WR1000.
WR1280	Is the signal P0B7 (U10P-4) always high? YES = WR1290 NO = WR1300
WR1290	Problem is U14R, U10P, U11P, U12P, or U14W. When repaired, refer to TTP WR1000.
WR1300	Problem is U10P or U8L. When repaired, refer to TTP WR1000.
WR1310	Problem is U14R, U4V, U4R, or U3J. When repaired, refer to TTP WR1000.

3-42. **Tachometer TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the tachometer circuitry.

STATEMENT NUMBER	
TA1000	Activate Service Aid 14 with tape unloaded. Check the signals at TP 70 and TP 72. Are they both a TTL clock that is high for 40.0 ±10 microseconds then low for 30.0 ±10 microseconds? YES = TA1020 NO = TA1010
TA1010	Problem is tachometer assembly, a bad cable connection, or U19T. When repaired, refer to TA1000.
TA1020	Is the signal at U18T-3 a clock that is high for 70.0 ±15 microseconds then low for 1.0 ±0.4 microseconds? YES = TA1060 NO = TA1030
TA1030	Is U18R-2 a 1.0 ±0.001MHz clock? YES = TA1050 NO = TA1040
TA1040	Problem is U8P. When repaired and U18R-2 is correct, refer to TA1000.
TA1050	The problem is U17R, U12F, U18T, or one of the destination IC's U18N, U17N, or U17T affecting the signal. When repaired, refer to TA1000.
TA1060	Is the signal at U18R-15 a clock that goes high for 1.0 ±0.4 microseconds then goes low for 70.0 ±15 microseconds? YES = TA1100 NO = TA1070
TA1070	Is the signal at TP 67 always low? YES = TA1080 NO = TA1090
TA1080	Problem is U18R, U18T, U17P, or U18P. When repaired, refer to TA1000.
TA1090	Problem is U18R, U17T, U18T, U17M, or U14L. When repaired, refer to TA1000.
TA1100	Is the signal PIASTR* (U17M-8) a clock that is low for 0.5 ±0.3 microsecond? YES = TA1120 NO = TA1110
TA1110	Problem is U17M, U17T, U18T, or U14L. When repaired, refer to TA1000.

STATEMENT NUMBER	
TA1120	Is the signal P1AØ (U17P-14) a 1.0 ±0.3 microsecond square-wave clock? YES = TA1130 NO = TA1200
TA1130	Is the signal P1A1 (U17P-13) a 2.0 ±0.5 microsecond square-wave clock? YES = TA1140 NO = TA1200
TA1140	Is the signal P1A2 (U17P-12) a 4.0 ±1.0 microsecond square-wave clock? YES = TA1150 NO = TA1200
TA1150	Is the signal P1A3 (U17P-11) an 8.0 ±2.0 microsecond square-wave clock? YES = TA1160 NO = TA1200
TA1160	Is the signal P1A4 (U18P-14) a 20.0 ±4.0 microsecond square-wave clock? YES = TA1170 NO = TA1200
TA1170	Is the signal P1A5 (U18P-13) a 35.0 ±8.0 microsecond square-wave clock? YES = TA1180 NO = TA1200
TA1180	Is the signal P1A6 (U18P-12) a clock that is high for greater than 1 microsecond and less than 6 microseconds? YES = TA1190 NO = TA1200
TA1190	Is the signal P1A7 (U18P-11) always low? YES = TA1210 NO = TA1200
TA1200	Problem is U17P, U18P, U17T, U14L, U18R, or U18T. When repaired, refer to TA1000.
TA1210	Is the signal P1B4 (U18N-14) a 70.0 ±12.0 microsecond square-wave clock? YES = TA1220 NO = TA1250
TA1220	Is the signal P1B5 (U18N-13) a 140.0 ±20.0 microsecond square-wave clock? YES = TA1230 NO = TA1250

STATEMENT NUMBER	
TA1230	Is the signal P1B6 (U18N-12) a 280.0 ±40.0 microsecond square-wave clock? YES = TA1240 NO = TA1250
TA1240	Is the signal P1B7 (U18N-11) always low? YES = TA1260 NO = TA1250
TA1250	Problem is U18N, U14L, or U17T. When repaired, refer to TA1000.
TA1260	Either CTCCLK0 (U17N-4), or CTCCLK1 (U17N-1) should be a 30.0 ±10.0 microsecond square-wave clock while the other clock should be low. Is it? YES = TA1270 NO = TA1280
TA1270	Step the test program by pressing the LOAD switch until the takeup motor changes direction. Check CTCCLK0 (U17N-4) and CTCCLK1 (U17N-1). Are the results the opposite of those observed in step TA1260? YES = TA1290 NO = TA1280
TA1280	Problem is U17N, U18N, U14L, or U14T. When repaired, refer to TA1000.
TA1290	Replace U14L and U14N. If the MTSU is still failing, we are unable to determine the fault.

3-43. **Interface Lines TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the interface lines (Service Aid 21).

STATEMENT NUMBER	
TI1000	**NOTE:** Pullups are required to check signals at the interface. If the MTSU is connected in a daisy-chain configuration and the computer system is using one of the other MTSU's, it will be necessary to change the failing MTSU's unit number to a value that will not be selected or polled by the computer. Example - If there are four MTSU's in the daisy-chain, change the unit number of the failing MTSU to unit 6. Activate Service Aid 21 to allow the following interface signals to toggle. This provides a loop to look at signals that may only occur once during normal operation. Which of the following interface signals are failing? IONL - refer to TTP TI1010 IRWD - refer to TTP TI1110 IFBY - refer to TTP TI1190 IRDY - refer to TTP TI1210 IDBSY - refer to TTP TI1230 IFPT - refer to TTP TI1250 ILDP - refer to TTP TI1270 IEOT - refer to TTP TI1290
TI1010	Is the signal P3A4 (TP 81) high for 5.0 ±1.0 microseconds? YES = TI1310 NO = TI1020
TI1020	Is the signal PULSE 1 (U2V-5) toggling? YES = TI1030 NO = TI1050
TI1030	Is the signal at U2V-2 toggling? YES = TI1040 NO = TI1060
TI1040	Problem is U2V, U6V, U8V, or U10L. When repaired, refer to TTP TI1000.
TI1050	Problem is U2W or U2V. When repaired and PULSE 1 is toggling, refer to TTP TI1000.
TI1060	Is the signal at U3V-1 always low? YES = TI1080 NO = TI1070

STATEMENT NUMBER	
TI1070	Problem is U2W, U4V, or U2V. When repaired, refer to TTP TI1000.
TI1080	Is the interface signal IRWU (U4W-9) low? YES = TI1090 NO = TI1100
TI1090	Problem is U4W, U10W, or the controller. When repaired, refer to TTP TI1000.
TI1100	Problem is U4W, U4V, U5V, or U3V. When repaired, refer to TTP TI1000.
TI1110	Is the signal at TP 87 high for 5.0 ±1.0 microseconds? YES = TI1310 NO = TI1120
TI1120	Is the signal PULSE 2 (U3V-10) toggling? YES = TI1140 NO = TI1130
TI1130	Problem is U2W or U3V. When repaired and U3V-10 is toggling, refer to TTP TI1000.
TI1140	Is the signal PULSE 3 (U4V-1) toggling? YES = TI1160 NO = TI1150
TI1150	Problem is U2W or U4V. When repaired, refer to TTP TI1000.
TI1160	Is the signal at U5W-10 toggling? YES = TI1170 NO = TI1180
TI1170	Problem is U2V, U3V, U4V, or U10V. When repaired and the signal at TP 87 is toggling, refer to TTP TI1000.
TI1180	Problem is U5W, U7V, or U2W. When repaired and U5W-10 is toggling, refer to TTP TI1000.
TI1190	Is the signal at TP 84 toggling? YES = TI1310 NO = TI1200
TI1200	Problem is U7V, U3V, U2W, or U7W. When repaired, refer to TTP TI1000.
TI1210	Is the signal at TP 82 toggling? YES = TI1310 NO = TI1220

STATEMENT NUMBER		
TI1220	Problem is U7V, U2W, or U7W. When repaired and the signal at TP 82 is toggling, refer to TTP TI1000.	
TI1230	Is the signal at TP 86 toggling?	
	YES = TI1310	NO = TI1240
TI1240	Problem is U7V, U7W, or U2W. When repaired and the signal at TP 86 is toggling, refer to TTP TI1000.	
TI1250	Is the signal at TP 83 toggling?	
	YES = TI1310	NO = TI1260
TI1260	Problem is U7W, U7V, or U2W. When repaired and TP 83 is toggling, refer to TTP TI1000.	
TI1270	Is the signal at TP 78 toggling?	
	YES = TI1310	NO = TI1280
TI1280	Problem is U7V, U2W, U8V, or U5W. When repaired and TP 78 is toggling, refer to TTP TI1000.	
TI1290	Is the signal at TP 85 toggling?	
	YES = TI1310	NO = TI1300
TI1300	Problem is U7V, U2W, or U8V. When repaired and the signal at TP 85 is toggling, refer to TTP TI1000.	
TI1310	In order to check out the output interface gate it will be necessary to have the interface unit select lines equal to the MTSU unit number. Is the signal FSEL (U8V-13) always high?	
	YES = TI1340	NO = TI1330
TI1330	Problem is U6V, U6W, or the unit select switch U8W. When repaired, refer to TTP TI1000.	
TI1340	Is the signal ONLSEL (TP 80) toggling?	
	YES = TI1380	NO = TI1350
TI1350	Is the signal at TP 81 toggling?	
	YES = TI1360	NO = TI1010
TI1360	Is the signal at U6V-13 toggling?	
	YES = TI1370	NO = TI1110

STATEMENT NUMBER	
TI1370	Problem is U6V or one of the destination IC's U8V, U7W, U4R, U17V, U17X, U18X, or U20X affecting the signal. When repaired, refer to TTP TI1000.
TI1380	Problem is U7W, U8V, U9V, cable connection between drive and controller, or the controller. When repaired, refer to TTP TI1000.

3-44. **EOT and BOT TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the BOT and EOT circuitry (Service Aids 22 and 23).

STATEMENT NUMBER		
BE1000	Switch MTSU power on to drive unit without a reel of tape installed. To check BOT, measure the voltage drop across R287. Is the voltage greater than 0.9 volt?	
	YES = BE1020	NO = BE1010
BE1010	To check EOT, measure the voltage drop across R292. Is the voltage greater than 0.9 volt?	
	YES = BE1020	NO = BE1070
BE1020	Insert a reel of tape and hand thread the tape through the tape path and around the takeup hub. Position the reflector strip away from the sensor.Verify that the tape is pulled tight and that there is no slack. Is the voltage across R287 less than 0.6 volt?	
	YES = BE1030	NO = BE1070
BE1030	Is the voltage across R292 less than 0.6 volt?	
	YES = BE1040	NO = BE1070
BE1040	Position the BOT reflector marker in front of the sensor. Verify the tape is pulled tight and doesn't have any slack. Is the voltage drop across R287 greater than 1.3 volts?	
	YES = BE1050	NO = BE1070
BE1050	Position the EOT reflector marker in front of the sensor. Is the voltage drop across R292 greater than 1.3 volts?	
	YES = BE1060	NO = BE1070
BE1060	If the MTSU doesn't detect the EOT or BOT marker during operation, problem is U2R, R343, or R342. Once repaired, refer to TTP BE1000.	

STATEMENT NUMBER		
BE1070	Is P4 pin 15 a 4.4 ±0.5Vdc level?	
	YES = BE1090	NO = BE1080
BE1080	Problem is R298 or C204. When P4 pin 15 is correct, refer to TTP BE1000.	
BE1090	Problem is the cables or the EOT/BOT assembly. When repaired, refer to TTP BE1000.	

3-45. **Compliance Arm TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the compliance arm circuitry (Service Aid 24).

STATEMENT NUMBER		
CA1000	Switch MTSU power on and activate Service Aid 24. The compliance arm should be at its full rest position. Measure the voltage at TP 64. Is it less than 4.76Vdc and greater than 2.4Vdc?	
	YES = CA1010	NO = CA1030
CA1010	Pull the compliance arm fully against the front stop. Is the voltage at TP 64 less than 2.0Vdc greater than 0.0Vdc?	
	YES = CA1020	NO = CA1160
CA1020	Is the voltage difference, from the readings taken in steps CA1000 and CA1010, between 2.4Vdc and 3.6Vdc?	
	YES = CA1200	NO = CA1190
CA1030	Is TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5 ±0.5kHz sawtooth signal?	
	YES = CA1110	NO = CA1040
CA1040	Is the signal CTCZC2 (U18M-11) a clock less than 42.0kHz and greater than 40.0kHz?	
	YES = CA1060	NO = CA1050
CA1050	Problem is U14N or U18M. When repaired and the signal CTCZC2 is correct, refer to TTP CA1000.	
CA1060	Disconnect the cable connector from P4. Is TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5kHz sawtooth signal?	
	YES = CA1070	NO = CA1080

STATEMENT NUMBER	
CA1070	Problem is a short in the cable assembly or air capacitor assembly. When repaired, refer to TTP CA1000.
CA1080	Is U17M-6 a 20.8 ±1.0kHz clock? YES = CA1100 NO = CA1090
CA1090	Problem is U17M or U18M. When repaired, refer to TTP CA1000.
CA1100	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1110	Measure the signal at TP 65. Is it a 4.0Vdc minimum, 10.5 ±0.5kHz clock? YES = CA1120 NO = CA1130
CA1120	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1130	Is P4 pin 20 a 0.2Vdc minimum, 10.5 ±0.5kHz clock? YES = CA1140 NO = CA1150
CA1140	Problem is U20N or supporting components. When repaired, refer to TTP CA1000.
CA1150	Problem is a bad cable connection or air capacitor. When repaired, refer to TTP CA1000.
CA1160	Is the signal at TP 68 a 12.0 ±1.0Vdc peak-to-peak 10.5 ±0.5kHz sawtooth signal? YES = CA1170 NO = CA1140
CA1170	Is the signal at TP 65 a 2.0Vdc maximum, 10.5 ±0.5kHz clock? YES = CA1180 NO = CA1190
CA1180	Problem is U10N or supporting components. When repaired, refer to TTP CA1000.
CA1190	Problem is U20N, supporting components, or the air capacitor assembly. When repaired, refer to TTP CA1000.
CA1200	With the compliance arm at its full rest position measure the voltage at TP 20. Is it greater than -8.0Vdc and less than 0.0Vdc? YES = CA1210 NO = CA1220

STATEMENT NUMBER	
CA1210	With the compliance arm fully against the front stop, is voltage at TP 20 less than 11.0Vdc and greater than 2.0Vdc? YES = CA1240 NO = CA1220
CA1220	Is the signal VOUT 1 (U3M-1) at a -0.2 ±0.4Vdc level? YES = CA1230 NO = Test D to A using Service Aid 11
CA1230	Problem is U5E or U4B. When repaired, refer to TTP CA1000.
CA1240	Switch MTSU power off. Using a jumper wire, ground pins 10 and 11 of U4B. Switch MTSU power on while pressing the TEST switch until the UNLOAD indicator illuminates. Does the voltage at TP 25 swing greater than +3.0Vdc and less than -3.0Vdc when the compliance arm is moved back and forth between its limits? YES = CA1260 NO = CA1250
CA1250	Problem is U4B or U3D. When repaired, refer to TTP CA1000.
CA1260	Problem is U12L. If the MTSU still fails, refer to the next section recommended in the troubleshooting table. Otherwise we are unable to determine the cause of the failure.

3-46. **Reel Seat Sensor and Tape-In-Path Sensor TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the reel seat sensor and tape-in-path sensor (Service Aid 31).

STATEMENT NUMBER	
HS1000	If testing the reel seat or file protect sensor, refer to TTP HS1010. If testing the tape-in-path sensor, refer to TTP HS1130.
HS1010	Install a tape reel with a write ring and activate Service Aid 31. Is the supply hub slowly rotating in the counterclock wise direction? YES = HS1020 NO = SE1000
HS1020	Does the UNLOAD indicator flash "on" when the file protect tab passes the sensor? YES = HS1030 NO = HS1060

STATEMENT NUMBER	
HS1030	Does the UNLOAD indicator flash "on" when the reel seat tab passes the sensor? YES = HS1040 NO = HS1060
HS1040	When slowing the supply reel down by hand, does the UNLOAD indicator flash twice when the reel seat tab passes by the sensor? YES = HS1045 NO = HS1050
HS1045	Stop Service Aid 31 and remove the reel of tape from the MTSU. Press the LOAD switch and verify the MTSU doesn't engage the hub lock. If not, the hub sensors are working correctly. If the MTSU does engage the hub lock, refer to TTP HS1080.
HS1050	Problem is incorrect supply hub height or the reel seat tab is bent out of place. When repaired, refer to TTP HS1000.
HS1060	Does P2A1 (TP 71) toggle as the tab passes by the sensor? YES = HS1070 NO = HS1080
HS1070	Problem is U12L. When repaired and the UNLOAD indicator is working, refer to TTP HS1000.
HS1080	The signal at P4 pin 7 should be less than 0.15Vdc when a tab is not located in front of the sensor and greater than 0.3Vdc when a tab is located in front of the sensor. Is it? YES = HS1090 NO = HS1100
HS1090	Problem is U19T or U12L. When repaired, refer to TTP HS1000.
HS1100	Is P4 pin 2 at a 4.4 ±0.5Vdc level? YES = HS1120 NO = HS1110
HS1110	Problem is R298, C204, or broken PWB etch going to P4 pin 2. When P4 pin 2 is correct, refer to TTP HS1000.
HS1120	Problem is U19T, the tab sensors, cable connection, or incorrect hub height. When repaired, refer to TTP HS1000.
HS1130	The following checks the tape-in-path sensor. Activate Service Aid 31. Is the LOAD/REWIND indicator illuminated on the front panel? YES = HS1140 NO = HS1150

STATEMENT NUMBER	
HS1140	Place your hand between the tape-in-path transmitter and receiver sensors. Does the LOAD/REWIND indicator extinguish? YES = HS1140 NO = HS1200
HS1145	The tape-in-path sensor is working correctly. If a problem still exists, refer to TTP HS1170 and TTP HS1210.
HS1150	Is P2A0 (TP 69) high? YES = HS1160 NO = HS1170
HS1160	Problem is U12L. When repaired, refer to TTP HS1000.
HS1170	Is P4 pin 9 greater than 0.3Vdc? YES = HS1180 NO = HS1190
HS1180	Problem is U19T or U12L. When repaired and TP 69 is high, refer to TTP HS1000.
HS1190	Problem is with tape-in-path sensors, sensor alignment, or a cable connection problem. When repaired, refer to TTP HS1000.
HS1200	Is the signal P2A0 (TP 69) low? YES = HS1160 NO = HS1210
HS1210	Is P4 pin 9 less than 0.15Vdc? YES = HS1220 NO = HS1230
HS1220	Problem is U19T or U12L. When repaired and TP 69 is low, refer to TTP HS1000.
HS1230	Problem is U19T or the light beam between the tape-in-path source and transmitter receiver has not been broken. When repaired, refer to TTP HS1000.

3-47. **Hub Lock and Door Lock TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the hub lock door and lock circuitry (Service Aid 32).

STATEMENT NUMBER	
HD1000	During this test the supply hub should rotate counter-clockwise while activating the hub lock and door lock solenoids. Also, if both the top cover and front door are not closed, the ON-LINE indicator should illuminate. Which of the following best describes the observed failure, if any? a. The hub lock solenoid is not working - refer to TTP HD1010. b. The hub lock solenoid is not working - refer to TTP HD1080. c. The top cover and front door are closed but the ON-LINE indicator is illuminated - refer to TTP HD1110.
HD1010	Is P3 pin 13 at a 24.0 ±5.0Vdc level? YES = HD1020 NO = HD1050
HD1020	Is the signal at TP 74 switching between 24.0Vdc ±5.0Vdc and 0.5Vdc? YES = HD1030 NO = HD1040
HD1030	Problem is cable connection or hub lock solenoid. When repaired, refer to TTP HD1000.
HD1040	Problem is U12L, R307, Q39, or a bad cable connection. When repaired, refer to TTP HD1000.
HD1050	Is P3 pin 4 at a 24.0 ±5.0Vdc level? YES = HD1060 NO = HD1070
HD1060	Problem is cable connection from power supply or power supply board. When repaired and P3 pin 4 is correct, refer to TTP HD1000.
HD1070	Problem is P3 pin 13 and P3 pin 4 should be connected. When repaired, refer to TTP HD1000.
HD1080	Is the signal at TP 75 switching between 24 ±5Vdc and 0.5Vdc? YES = HD1090 NO = HD1100
HD1090	Problem is front-panel door lock solenoid. When repaired and TP 75 is correct, refer to TTP HD1000.

STATEMENT NUMBER	
HD1100	Problem is U12L, R308, Q40, or a bad cable connection. When repaired and TP 75 is going to ground, refer to TTP HD1000.
HD1110	With both front panel door and top cover closed, is the signal P2A2, U12L-13 low? YES = HD1120 NO = HD1040
HD1120	Open one door at a time. Is P2A2 (U12L-13) high? YES = HD1030 NO = HD1040
HD1130	Problem is U12L. When repaired and ON-LINE indicator is working correctly, refer to TTP HD1000.
HD1140	The problem is the cable connection, U12L or the microswitch. When repaired, refer to TTP HD1000.

3-48. **Blower Motor TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the blower motor circuit (Service Aid 34).

STATEMENT NUMBER	
BL1000	Activate Service Aid 34 with tape unloaded. Does the blower motor start running? YES = BL1010 NO = BL1020
BL1010	Press the LOAD switch once. The LOAD indicator should extinguish and the blower motor should come to a stop. Does it? YES = DONE NO = BL1070
BL1020	Is P5 pin 2 between +5.0Vdc and +6.0Vdc? YES = BL1030 NO = BL1040
BL1030	Problem is the blower motor, power supply, or a cable connection. When repaired, refer to TTP BL1000.
BL1040	Is the signal P2B4 (U3K-12) low? YES = BL1050 NO = BL1060
BL1050	Problem is U3K or supporting components. When problem is repaired, refer to TTP BL1000.

STATEMENT NUMBER	
BL1060	Problem is U12L or Service Aid 34 wasn't selected. When repaired, refer to TTP BL1000.
BL1070	Is P5 pin 2 less than +0.5Vdc? YES = BL1080 NO = BL1090
BL1080	Problem is the power supply or motor. When repaired, refer to TTP BL1000.
BL1090	Is the signal P2B4 (U3K-12) high? YES = BL1110 NO = BL1100
BL1100	Problem is U12L. When repaired, refer to TTP BL1000.
BL1110	Problem is U3K or supporting components. When repaired, refer to TTP BL1000.

3-49. **Drive Selection TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the drive selection circuits.

STATEMENT NUMBER	
DS1000	The following should be used when the system diagnostic program is unable to select the MTSU. Are the unit address switches set to equal the MTSU number being tested? YES = DS1020 NO = DS1010
DS1010	Change unit select switch to equal the address of MTSU being tested. When correct, refer to TTP DS1000.
DS1020	Is the signal FSEL (U6V-8) high? YES = DS1060 NO = DS1030
DS1030	Are the interface unit select lines IFAD, ITAD1, ITAD0 set correctly with the unit number being tested? YES = DS1050 NO = DS1040
DS1040	Problem is interface cables or controller. When problem is corrected and interface lines equal unit number, refer to TTP DS1000.

STATEMENT NUMBER	
DS1050	FSEL (U6V-8) should be high. If not, the problem is U6V, U6W, or unit select switch U8W. When problem is corrected, refer to TTP DS1000.
DS1060	Is the MTSU front panel ON-LINE indicator illuminated? YES = DS1080 NO = DS1070
DS1070	Press the ON-LINE switch on the front panel to place the drive on-line. Did the ON-LINE indicator illuminate? YES = DS1080 NO = DS1075
DS1075	Problem is switch panel, bad cable connection, U17L, or U10L. When repaired, refer to TTP DS1000.
DS1080	Is the signal IONL (U8V-3) low? YES = DS1100 NO = DS1090
DS1090	The problem is U8V, U2V, U2W, or U6V. When the problem is corrected and IONL (U8V-3) is low, refer to TTP DS1000.
DS1100	Is the signal IRDY (U7W-6) low? YES = DS1160 NO = DS1110
DS1110	Is the signal at TP 80 high? YES = DS1120 NO = DS1130
DS1120	Problem is U7W, U7V, or U2W. When repaired and IRDY (U7W-6) is low, refer to TTP DS1000.
DS1130	Is the signal at U3V-8 always high? YES = DS1140 NO = DS1150
DS1140	Problem is U6V or one of the destination IC's U8V, U7W, U4R, U17X, U17V, U18X, or U20X affecting the signal. When repaired and TP 80 is high, refer to TTP DS1000.
DS1150	Troubleshoot the IRWD interface line using Service Aid 21. Refer to TTP TI1000.
DS1160	If the MTSU is on-line and ready, the problem must be with the interface cables or the controller. When the problem is corrected, the system program should be able to select the MTSU.

3-50. **Command Lines TTP.** This TTP describes the diagnostic steps required to isolate a malfunction within the command lines.

STATEMENT NUMBER	
CL1000	It is the responsibility of the system program to detect a failure in this area. Which of the following best describes the failure if any? a. A command was sent; however, no tape motion occurred and IFBY did not go true. If so, refer to TTP CL1010. b. The tape drive fails with an illegal command fault code. If so, refer to TTP CL1070. c. The tape drive executes a different command than was sent. If so, refer to TTP CL1070.
CL1010	Put the system program in a loop to continually send a no-operation command. Is the signal IGO, P1, pin 8 going low for a minimum of 1 microsecond and no longer than 1 second? YES = CL1030 NO = CL1020
CL1020	Problem is the controller not sending an IGO pulse, bad cable connection, or failure of U3W, U5V, or U5W. When repaired, refer to TTP CL1000.
CL1030	Is the signal FSEL (U6V-8) high during the time IGO is low? YES = CL1040 NO = DS1000
CL1040	Is the signal POASTR* (U5V-11) at a low level only while IGO, U5W-13 is low? YES = CL1050 NO = CL1060
CL1050	Problem is U8L. When repaired, refer to TTP 1000.
CL1060	Problem is U5W, U5V, or U8L. When repaired, refer to TTP CL1000.
CL1070	Problem is U4W, U5W, U3W, or U8L. When repaired, refer to TTP CL1000.

3-51. **Read Formatter TTP.** This TTP describes the diagnostic steps required to check the read formatter logic. The circuitry is located on pages 7 - 10 of the multi-page schematic.

STATEMENT NUMBER	
RF1000	Determine if the errors are being caused by the Write or Read circuits by reading a tape that is known to be good. If the errors persist while reading the good tape, the problem is in the read circuits and this TTP should be used. If errors are not detected while reading the good tape, it can be assumed that the write circuitry is the cause of the original errors and the procedure starting at WR1000 should be used.

NOTE

A good tape is defined as a tape containing record blocks that are greater than 18 and less than 2046 bytes, that the data in each block guarantees all data lines are changing, and there are no hard errors or corrected errors.

Before beginning, verify the following:

a. All cables are mated with the appropriate connectors, are properly seated, and are not inverted.

b. The AC line voltage is within operating limits and has the correct frequency.

c. The head, tape cleaner, and tape guides are clean and in good condition.

To use this troubleshooting procedure remove the write enable ring from tape and load tape on the transport. Unless otherwise specified, select Service Aid 23 for 25 ips operation.

This document covers two approaches to locating the failure. The first approach discussed is when the computer system can provide failure symptom information. The second approach is when the computer system is incapable of supplying information other than that the drive doesn't work.

Failure Information (supplied by system)

With failure information the circuitry most likely to be at fault can be determined. Which of the following best describes the failure?

a. Transport doesn't send any read strobes or read data information to controller. Refer to TTP RF1010.

STATEMENT NUMBER

RF1000 (cont.)

b. Transport does send read data but is also sending hard error or corrected error information to controller. Refer to TTP RF1020.

c. Transport doesn't send or is always sending file mark status to controller. Refer to TTP RF3100.

d. Transport doesn't send or is always sending ID burst status to controller. Refer to TTP RF3000.

e. Transport sends incorrect data without indicating a hard error to controller. Refer to TTP RF3300.

f. The transport goes into a runaway condition when sent a read command to controller. Refer to TTP RF1010.

If the symptom isn't described above or if after following the statements called out the problem wasn't resolved, it will be necessary to step through each troubleshooting routine to locate the failure. Follow the instruction under "System Incapable of Supplying Failure Information."

System Incapable of Supplying Failure Information

Read Amplifiers - Starting at RF4000.
Read Control - Starting at RF2300.
Read Multiplexer - Starting at RF7100.
Read Clock - Starting at RF2000.
Read Data Lines - Starting at RF3300.
Read Strobe - Starting at RF3200.
Scan Generator - Starting at RF5000.
File Mark - Starting at RF3100.
Error Detect and Postamble - Starting at RF7500.
ID Burst - Starting at RF3000.
Read Control - Starting at RF2100.
Data Extractors - Starting at RF6100.
Skew Buffer - Starting at RF7300.

If after checking all the above circuits the failure still exists, we are unable to determine the cause of the problem or the failure is not located in the read formatter logic.

RF1010

Since the failure could be located in several different areas, it will be necessary to isolate the problem by checking the following circuits:

a. Read Control - Refer to TTP RF2300.
b. Read Multiplexer - Refer to TTP RF7100.
c. Read Control Register - Refer to TTP RF2100.
d. Read Strobe - Refer to TTP RF3200.
e. Read Data - Refer to TTP RF3300.
f. Return to TTP RF1000.

STATEMENT NUMBER	
RF1020	Isolate the problem by checking the read formatter circuits in the following order: a. Read Amplifiers - Refer to TTP RF4000. b. Read Multiplexers - Refer to TTP RF7100. c. Error Detect and Postamble - Refer to TTP RF7500. d. Return to TTP RF1000.
RF2000	In this section the read clock circuitry will be checked. The read clock logic is located in page 9 of the multi-page schematic. Load the good tape and select Service Aid 23 for 25 ips. Press the LOAD switch once and tape motion should stop. Measure the frequency at TP 93. Is it between 870kHz and 890kHz? YES = RF2010 NO = RF2030
RF2010	Initiate high speed, then stop tape motion. Is the clock at TP 93 between 3.48MHz and 3.56MHz? YES = RF2020 NO = RF2015
RF2015	Is the signal P0B5 zero (U12F-8) low if 25 ips is selected or high if 100 ips is selected? YES = RF2035 NO = RF2085
RF2020	Initiate low speed tape motion. Are the signals DCLK1 (TP 3) and DCLK2 (TP10) both toggling? YES = RF2025 NO = RF6100
RF2025	The read clock circuitry appears to be working correctly; return to the main troubleshooting routine that sent you here.
RF2030	Is the signal at U3G-8 always high? YES = RF2040 NO = RF2015
RF2035	Problem is U3G, U5G, U7H, U2G, or supporting components. When repaired, refer to TTP RF1000.
RF2040	Is the signal at U5G-1 a 40.0 ±1.0kHz clock? YES = RF2045 NO = RF2070
RF2045	Is the signal at U3G-6 toggling? YES = RF2050 NO = RF2035

STATEMENT NUMBER		
RF2050	Is the signal at U5G-3 toggling?	
	YES = RF2035	NO = RF2055
RF2055	Is the signal at TP 93 toggling?	
	YES = RF2060	NO = RF2065
RF2060	Problem is U3H, U2H, or U1J. When repaired and the signal at U5G-3 is toggling, refer to TTP RF1000.	
RF2065	Problem is U2G or one of the destination chips U1H, U2H, U3H, U5H, U5F, U6A, U6B, U6F, U6G, U7A, U7B, U7D, U7F, U8F, U8E, U9A, U9B, U9C, U9D, U9F, U10B, U10C, U10D, U10E, U11D, U12V, U13A, U13B, U13C, U13D, U13E, U13F, U13G, U13V, U14V, U15V, or U19V. When repaired, refer to TTP RF1000.	
RF2070	Is the signal at U9R-3 an 80.0 $\pm$2.0kHz clock?	
	YES = RF2075	NO = WR1000
RF2075	Is U7E-2 always low?	
	YES = RF2080	NO = RF2300
RF2080	Problem is U7E, U9R, or U5G. When repaired, refer to TTP RF1000.	
RF2085	Problem is with U8L, U12F, or one of the destination IC's U7H or U10H. When repaired, refer to TTP RF1000.	
RF2100	In this section the read control register will be checked. The read control logic is located on page 10 of the multi-page schematic.	
	Are the signals ENFMG (U18V-2), ENRD (U18V-7), and FWD (U18V-10) all toggling?	
	YES = RF2110	NO = RF2130
RF2110	Is the signal at U18V-15 always low?	
	YES = RF2120	NO = RF2150
RF2120	The read control register is working correctly. Return to the main troubleshooting flow.	

STATEMENT NUMBER	
RF2130	Is the signal PULSE 5 (U18V-9) toggling? YES = RF2150 NO = RF2140
RF2140	Problem is U2W, U18V, or U18W. When repaired, refer to TTP RF1000.
RF2150	If the failing signal was ENFMG the problem is caused by U18V, U2H, U5H, or U3K. If the failing signal was ENRD, the problem is caused by U18V, U19W, U19X, or U2J. If the failing signal was FWD, the problem is U18V or one of the destination IC's U12D, U12C, U12F, U12B, or U12G. If the failing signal was U18V-15, the problem is U18V or U17V. When the failure is repaired, refer to TTP RF1000.
RF2300	In this section the read control circuitry will be checked. The read control logic is located on page 9 of the multi-page schematic. Select Service Aid 23 for 25 ips operation. Check the following RDROP signals. Are they all toggling? RDROPP* U12H-5 RDROP0* U12H-1 RDROP1* U12H-14 RDROP2* U12H-2 RDROP3* U12H-7 RDROP4* U12H-15 RDROP5* U12H-4 RDROP6* U12H-6 RDROP7* U12H-3 YES = RF2310 NO = RF4020
RF2310	Are both the signals at U5H-14 and U5H-13 toggling? YES = RF2330 NO = RF2320
RF2320	Problem is U12H, U6H, U5H, U7E, or U3K. When repaired, refer to TTP RF1000.
RF2330	Is the signal PECLK (U5H-12) a clock between 870 and 890 kHz? YES = RF2340 NO = RF2000
RF2340	Is the signal BLOCK (U5H-10) toggling? YES = RF2350 NO = RF2380

STATEMENT NUMBER	
RF2350	Is the signal P3A2 (U2H-6) toggling? YES = RF2360 NO = RF2400
RF2360	Is the signal PENAB* (U3J-8) toggling? YES = RF2370 NO = RF2410
RF2370	The read control circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF2380	Is the signal ENFMG (U5H-15) toggling? YES = RF2390 NO = RF2100
RF2390	Problem is U5H, U2J, or U1H. When repaired, refer to TTP RF1000.
RF2400	Problem is U5H, U1H, U2H, or U10L. When repaired, refer to TTP RF1000.
RF2410	Is the signal at U2J-8 toggling? YES = RF2420 NO = RF2430
RF2420	Problem is U3J or one of the destination IC's U11C, U12E, U13E, U13F, U13H, U11B, U13B, U11F, U11E, or U13C. When repaired, refer to TTP RF1000.
RF2430	Is the signal ENRD (U2J-9) toggling? YES = RF2440 NO = RF2100
RF2440	Is U5H-2 always low? YES = RF2450 NO = RF3100
RF2450	Problem is with U5H, U2J, or one of the destination IC's U3J, U12V, U6F, U9F, U6G. When repaired, refer to TTP RF1000.
RF3000	In this section the ID burst logic will be checked. The circuitry is located on page 9 of the multi-page schematic. Remove the write enable ring from a good tape that is written in 1600 bpi phase encode and install in the drive. Select Service Aid 23 and press the LOAD switch for 25 ips operation. As the drive performs the read from load point, the drive should first send the ID burst status. It is necessary to terminate Service Aid 23 and reselect it for every ID burst pulse. A better troubleshooting loop can be accomplished if the command string of read, rewind, and loop can be executed by the computer system.

STATEMENT NUMBER	
RF3000 (con't.)	Does U6H-2 go high for a minimum of 4 milliseconds? YES = RF3010 NO = RF3060
RF3010	Does the signal ENFMG (U3K-5) go high when the BOT marker moves past the read/write head? YES = RF3020 NO = RF2300
RF3020	The signal IDENT P2 pin 16 should remain high when reading from load point. Does it? YES = RF3040 NO = RF3030
RF3030	The problem is U6V, U3K, cable connection between drive and controller, or the controller. When repaired, refer to TTP RF1000.
RF3040	In order to check out the output interface gate, the drive must be on-line and executing a read command. Does P2 pin 16 go low when reading from BOT? YES = RF3050 NO = RF3030
RF3050	The ID burst circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF3060	The problem is U12H, U6H, or U6V. When repaired, refer to TTP RF1000.
RF3100	In this section the file mark logic will be checked. This circuitry is located on page 9 of the multi-page schematic. Load a scratch tape that is write-enabled. Select Service Aid 21 and adjust R115 so the UNLOAD indicator is always illuminated. Is the signal P3A3 (U5H-6) toggling? YES = RF3110 NO = RF3150
RF3110	U17X-8 should always be high. Is it? YES = RF3130 NO = RF3120
RF3120	The problem is U17X cable connection between drive and controller, or the controller. When repaired, refer to TTP RF1000.

STATEMENT NUMBER	
RF3130	In order to check out the interface gate, the drive must be on-line and in a loop writing file marks. Does U17X-8 toggle? YES = RF3140 NO = RF3120
RF3140	The file mark circuitry is working correctly. Return to the troubleshooting routine that sent you here. Refer to paragraph 6-17 for instructions on final read threshold adjustment.
RF3150	Is the signal ENFMG (U5H-1) toggling? YES = RF3160 NO = RF2300
RF3160	Is the signal PECLK (U5H-4) toggling? YES = RF3170 NO = RF2000
RF3170	Check the following signals. Are the signals RDROP1*, RDROP3*, RDROP4* always low and the rest toggling? YES = RF3180 NO = RF4020 RDROPP* U12H-5 RDROP1* U12H-14 RDROP3* U12H-7 RDROP5* U12H-4 RDROP7* U12H-3 RDROP0* U12H-1 RDROP2* U12H-2 RDROP4* U12H-15 RDROP6* U12H-6
RF3180	The problem is U12H, U6H, U5H, or U17X. When repaired, refer to TTP RF1000.
RF3200	In this section the read strobe circuitry will be checked. The read strobe logic is located on page 10 of the multi-page schematic. Load the good tape without the write enable ring. Select Service Aid 23 for 25 ips operation. Is there an active signal at U17W-5 with a positive going pulse width of 1.3 to 1.7 microseconds and with the same frequency (±5 kHz) as U17W-1? YES = RF3210 NO = RF3250
RF3210	The signal IRSTR (U17V-11) should always be high. Is it? YES = RF3230 NO = RF3220

STATEMENT NUMBER	
RF3220	Problem is with U17V, cable connection between drive and controller, or controller. When repaired, refer to TTP RF1000.
RF3230	In order to check out the output interface gate, the drive must be on-line and executing a read command. Is there an active signal at U17V-11? YES = RF3240 NO = RF3220
RF3240	The read strobe circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF3250	Is U7W-1 high and U7W-2 toggling? YES = RF3260 NO = RF7500
RF3260	Problem is U17W, U17V, or supporting components. When repaired, refer to TTP RF1000.
RF3300	In this section the data output logic will be checked. The data output circuitry is located on page 10 of the multi-page schematic. Load the good tape without a write enable ring. Select Service Aid 23 for 25 ips operation. Check for a signal on U18W pins 2, 7, 10, and 15. Are they always low? YES = RF3330 NO = RF3310
RF3310	Is the signal PULSE5 (U18W-9) toggling? YES = RF3320 NO = RF2100
RF3320	Problem is U18W or U18X. When repaired, refer to TTP RF3300.
RF3330	Check the following locations. Do they all have a signal that is toggling? U19W-10 U19X-2U19X-5 U19W-12 U19X-15U19X-7 U19W-15 U19X-12U19X-10 YES = RF3370 NO = RF3340
RF3340	Are the signals at U19V-1, U19X-9, and U19X-1 all toggling? YES = RF3350 NO = RF7500

STATEMENT NUMBER	
RF3350	Is the signal PECLK (U19V-8) a clock between 870 and 890 kHz? YES = RF3360 NO = RF2000
RF3360	The problem is U19V, U19X, U19W, or one of the destination IC's U17V, U17X, U18X or U20X. When repaired, refer to TTP RF3300.
RF3370	Check the following locations. Are they all high? U17V-6 U17X-6 U20X-8 U17V-3 U20X-3 U20X-11 U17X-11 U20X-6 U18X-6 YES = RF3390 NO = RF3380
RF3380	Problem is with U17V, U17X, U18X, U20X, cable connection between drive and controller, or controller. When repaired, refer to TTP RF3300.
RF3390	In order to check out the interface gates the drive must be online and executing a read command. Are the following locations all toggling? U17V-6 U17X-6 U20X-8 U17V-3 U20X-3 U20X-11 U17X-11 U20X-6 U18X-6 YES = RF3399 NO = RF3380
RF3399	The read data circuitry is working correctly. Return to the troubleshooting routine that sent you here.
RF4000	In this section the read amplifiers will be checked. The read amplifier logic is on page 7 of the multi-page schematic. Power up the transport and before loading a tape reel, check TP 94. Is it a level between 0.10 and 0.70 volt? YES = RF4010 NO = RF4220

STATEMENT NUMBER

RF4010 Initialize the drive to Service Aid 23 and initiate low speed. Does the signal on all the following test points swing between +1.0 and +8.0 and -1.0 and -8.0 volts?

YES = RF4015 NO = RF4110

Channel P = TP 50
Channel 0 = TP 44
Channel 1 = TP 46
Channel 2 = TP 48
Channel 3 = TP 52
Channel 4 = TP 40
Channel 5 = TP 56
Channel 6 = TP 42
Channel 7 = TP 54

RF4015 The input read amplifiers are presumed to be working correctly. Return to the TTP that sent you here.

RF4020 Initialize the drive to Service Aid 23 and select 25 ips. Do all the following locations have a signal that swings more positive than 1.0 volt and more negative than -1.0 volt?

YES = RF4040 NO = RF4030

Channel P = U15F-4
Channel 0 = U15C-4
Channel 1 = U15D-4
Channel 2 = U14F-4
Channel 3 = U15G-4
Channel 4 = U15A-4
Channel 5 = U15H-4
Channel 6 = U14C-4
Channel 7 = U14H-4

RF4030 Depending on which channel or channels are failing, replace the following components. When repaired, refer to TTP RF1000.

Channel P = U15F, C106, or R191
Channel 0 = U15C, C83, or R158
Channel 1 = U15D, C85, or R176
Channel 2 = U14F, C89, or R180
Channel 3 = U15G, C108, or R202
Channel 4 = U15A, C52 or R136
Channel 5 = U15H, C126 or R224
Channel 6 = U14C, C53 or R154
Channel 7 = U14H, C123 or R213

RF4040 Are all the following signals toggling?

YES = RF4060 NO = RF4050

RDATAP = U14D-8
RDATA0 = U14B-8
RDATA1 = U14D-10
RDATA2 = U14D-12
RDATA3 = U14G-10
RDATA4 = U14B-10
RDATA5 = U14G-8
RDATA6 = U14B-12
RDATA7 = U14G-12

STATEMENT NUMBER	
RF4050	Depending on which channel or channels are failing, replace the following components. When repaired, refer to TTP RF1000. RDATAP = U15F, U14D, OR U13D RDATA0 = U15C, U14B, OR U13A RDATA1 = U15D, U14D, OR U13D RDATA2 = U14F, U14D, OR U13D RDATA3 = U15G, U14G, OR U13G RDATA4 = U15A, U14B, OR U13A RDATA5 = U15H, U14G, OR U13G RDATA6 = U14C, U14B, OR U13A RDATA7 = U14H, U14G, OR U13G
RF4060	Are all the following signals toggling? YES = RF4080 NO = RF4070 RDROPP* = U14D-4 RDROP4* = U14B-6 RDROP0* = U14B-4 RDROP5* = U14G-4 RDROP1* = U14D-6 RDROP6* = U14B-2 RDROP2* = U14D-2 RDROP7* = U14G-2 RDROP3* = U14G-6
RF4070	Depending on which signal or signals are failing, replace the following components. When repaired, refer to TTP RF1000. RDROPP* = U15F, U14D, U13E, OR U12H RDROP0* = U15C, U14B, U13B, OR U12H RDROP1* = U15D, U14D, U13E, OR U12H RDROP2* = U14F, U14D, U13F, OR U12H RDROP3* = U15G, U14G, U13F, OR U12H RDROP4* = U15A, U14B, U13C, OR U12H RDROP5* = U15H, U14G, U13H, OR U12H RDROP6* = U14C, U14B, U13B, OR U12H RDROP7* = U14H, U14G, U13H, OR U12H
RF4080	Initiate 100 ips operation. Measure the signal at the following test points. Do they all swing between +0.3 to +0.7 volt and -0.3 to -0.7 volt? YES = RF4130 NO = RF4090 Channel P = TP 49 Channel 4 = TP 39 Channel 0 = TP 43 Channel 5 = TP 55 Channel 1 = TP 45 Channel 6 = TP 41 Channel 2 = TP 47 Channel 7 = TP 53 Channel 3 = TP 51

STATEMENT NUMBER	
RF4090	Measure the voltage across R114. Is it less than 0.2 volt? YES = RF4100 NO = RF4160
RF4100	Depending on which channel is failing, replace the following components. If after replacing the listed components the failure still exists, replace the head assembly. When repaired, refer to TTP RF1000. Channel P = Q31, U19F, C99, R197, C100, C102, or R198 Channel 0 = Q28, U19C, C73, R164, C74, C70, or R165 Channel 1 = Q29, U19D, C76, R167, C77, C79, or R169 Channel 2 = Q30, U19E, C95, R186, C96, C93, or C187 Channel 3 = Q32, U19G, C112, R208, C113, C115, or R209 Channel 4 = Q26, U19A, C60, R142, C61, C58, or R144 Channel 5 = Q34, U19I, C133, R230, C134, C129, or R231 Channel 6 = Q27, U19B, C64, R145, C65, C67, or R146 Channel 7 = Q33, U19H, C119, R219, C120, C117, or R220
RF4110	Depending on which channel or channels are failing, check the appropriate test point. Does the signal swing between +0.3 to +0.7 volt and -0.3 to -0.7 volt? YES = RF4120 NO = RF4100 Channel P = TP 49 Channel 0 = TP 43 Channel 1 = TP 45 Channel 2 = TP 47 Channel 3 = TP 51 Channel 4 = TP 39 Channel 5 = TP 55 Channel 6 = TP 41 Channel 7 = TP 53
RF4120	Depending on which channel is failing, replace the following components. When repaired, refer to TTP RF1000. Channel P = U17F Channel 0 = U17C Channel 1 = U17D Channel 2 = U17E Channel 3 = U17G Channel 4 = U17A Channel 5 = U17I Channel 6 = U17B Channel 7 = U17H
RF4130	Measure the peak voltage at TP 57. Is it greater than 0.1 volt? Use TP 1 for ground reference. YES = RF4140 NO = RF4150
RF4140	Select Service Aid 12 and measure the peak voltage at TP 57. Is it greater than 0.1 volt? Use ground TP 1 for reference. YES = RF4190 NO = RF4150

STATEMENT NUMBER	
RF4150	The read amplifiers appear to be working correctly. If the problem has not been found and corrected, return to the troubleshooting routine which brought you to the read amplifiers.
RF4160	Make the following measurements while alternating between 100 ips and 25 ips. Does the signal at U12F-10 toggle with each speed change? YES = RF4180 NO = RF4170
RF4170	Problem is U8L or U12F. When repaired, refer to TTP RF1000.
RF4180	Problem is U10H, Q25, or the supporting components. When repaired, refer to TTP RF1000.
RF4190	Is the signal P3B6 (U10L-33) high? YES = RF4200 NO = RF4210
RF4200	Problem is U10L or U12V. When repaired and U10L-33 is low, refer to TTP RF1000.
RF4210	Problem is U12V or the supporting components. When repaired and TP 57 is correct, refer to TTP RF1000.
RF4220	Measure the voltage at TP 94 while adjusting R115. Can the voltage be adjusted between 0.1 and 0.7 volt? YES = RF4230 NO = RF4240
RF4230	Adjust R115 per read threshold adjustment procedure, then refer to TTP RF1000.
RF4240	Problem is with U2N, U3M, or R115. When repaired, adjust R115 per read threshold adjustment procedure, then refer to TTP RF1000.
RF5000	The following guide should be used when troubleshooting the scan generator. The scan generator circuitry is located on page 9 of the multi-page schematic. Are the following signals toggling: a (U8D-1) b (U8D-2) c (U8D-3)? YES = RF5010 NO = RF5040
RF5010	Is the signal SCANP (U7H-6) toggling? YES = RF5020 NO = RF5110

STATEMENT NUMBER	
RF5020	Are all eight SCAN signals toggling? To determine this, check the following locations: SCAN0, U8D-15 SCAN1, U8D-14 SCAN2, U8D-13 SCAN3, U8D-12 SCAN4, U8D-11 SCAN5, U8D-10 SCAN6, U8D-9 SCAN7, U8D-7 YES = RF5030 NO = RF5120
RF5030	The scan generator is working correctly. Return to the troubleshooting flow that sent you here.
RF5040	Is the signal PECLK (U7D-2) toggling? YES = RF5060 NO = RF5050
RF5050	Troubleshoot the PE clock generator starting at RF2000.
RF5060	Is the signal SCANP (U7H-6) always low? YES = RF5080 NO = RF5070
RF5070	Problem is U7D or one of the destination IC's U8D, U7C, U10F, U10G. When repaired, refer to TTP RF1000.
RF5080	Is the signal PSEL (U7H-5) high? YES = RF5100 NO = RF5090
RF5090	Problem is U7H or one of the destination IC's U10V, U7D, U8A. When repaired, refer to TTP RF1000.
RF5100	Problem is U7D or one of the destination IC's U5F, U7G, U7H, U8D, U9E, U14V. When repaired, refer to TTP RF1000.
RF5110	Is the signal PSEL (U7H-5) toggling? YES = RF5090 NO = RF5100
RF5120	If the failing signal is SCAN5 or SCAN6, problem is U8D or U8A. If the failing signal is SCAN0, SCAN2, SCAN4, or SCAN7, problem is U8D or U8B. If the failing signal is SCAN1 or SCAN3, problem is U8D or U8C. When failing IC is replaced, refer to TTP RF1000.

STATEMENT NUMBER

RF6100

The following guide should be used when troubleshooting the Data Extractors. The guide has been written for the parity channel. If troubleshooting a different channel, use the cross-reference chart located below or reference page 8 of the multi-page schematic. Select Service Aid 23 for 25 ips operation.

CROSS REFERENCE CHART

	CHANNELS							
P	1	2	3	4	5	6	7	0
U12C-5	U12D-9	U12D-12	U12G-9	U12C-13	U12G-12	U12B-1	U12F-5	U12B-13
U11C-12	U11C-9	U12E-4	U11F-2	U11E-9	U12E-9	U11B-4	U11E-1	U11B-10
U13D-9	U13D-9	U13D-9	U13G-9	U13A-9	U13G-9	U13A-9	U13G-9	U13A-9
U8A-13	U8C-9	U8B-5	U8C-11	U8B-11	U8A-3	U8A-5	U8B-9	U8B-3
U13D-6	U13D-4	U13D-3	U13G-4	U13A-3	U13G-3	U13A-4	U13G-6	U13A-6
U13E-13	U13E-3	U13F-13	U13F-3	U13C-3	U13H-13	U13B-13	U13H-3	U13B-3
TP 30	TP 32	TP 28	TP 29	TP 34	TP 33	TP 31	TP 35	TP 27
U9E	U10G	U10G	U10G	U10G	U10G	U10G	U10G	U10G
U13E-9	U13E-7	U13F-9	U13F-7	U13C-7	U13H-9	U13B-9	U13H-7	U13B-7
U13D-10	U13D-12	U13D-15	U13G-12	U13A-15	U13G-15	U13A-12	U13G-10	U13A-10
U6A-9	U7B-9	U7A-7	U13C-9	U6B-7	U7A-9	U6A-7	U6B-9	U7B-7
U12C-6	U12D-8	U12D-11	U12G-8	U12C-11	U12G-11	U12B-3	U12F-6	U12B-11
U11C-11	U11C-8	U12C-6	U11F-3	U11E-8	U12E-8	U11B-6	U11E-3	U11B-8
U9C	U10C	U9D	U11D	U10E	U9A	U9B	U10D	U10B
U9C-15	U10C-15	U9D-15	U11D-15	U10E-15	U9A-15	U9B-15	U10D-15	U10B-15
U11C-3	U11C-6	U12E-3	U11F-6	U11E-6	U12E-11	U11B-3	U11E-11	U11B-11
U8C-12	U8C-4	U8C-6	U8A-10	U8A-8	U8A-2	U8B-12	U8C-2	U8B-2
U6A-13	U7B-13	U7A-3	U13C-13	U6B-3	U7A-13	U6A-3	U6B-13	U7B-3
U6A-9	U7B-9	U7A-7	U13C-9	U6B-7	U7A-9	U6A-7	U6B-9	U7B-7
U8A	U8C	U8B	U8C	U8B	U8A	U8A	U8B	U8B

STATEMENT NUMBER		
RF6110	Is the signal FWD (U12C-5) toggling?	
	YES = RF6120	NO = RF2100
RF6120	Is the signal PENAB* (U11C-12) toggling?	
	YES = RF6130	NO = RF2300
RF6130	Is the signal PECLK (U13D-9) toggling?	
	YES = RF6140	NO = RF2000
RF6140	Is the signal SCANP (U8A-13) toggling?	
	YES = RF6150	NO = RF5000
RF6150	Are the signals RDATAP (U13D-6) and RDROPP* (U13E-13) both toggling?	
	YES = RF6160	NO = RF4020
RF6160	Is the signal CHDROPP (TP 30) toggling?	
	YES = RF6180	NO = RF6170
RF6170	Problem is U13E or U9E. When repaired, refer to TTP RF1000.	
RF6180	Is the signal at U13D-10 toggling?	
	YES = RF6200	NO = RF6190
RF6190	Problem is U13D or U12C. When repaired, refer to TTP RF1000.	
RF6200	Is the signal DATAP (U12C-6) toggling?	
	YES = RF6220	NO = RF6210
RF6210	Problem is U12C, U9C, or U9E. When repaired, refer to TTP RF1000.	
RF6220	Is the signal at U11C-11 toggling?	
	YES = RF6240	NO = RF6230
RF6230	Problem is U12C, U11C, or U9C. When repaired, refer to TTP RF1000.	
RF6240	Is the signal at U9C-15 toggling?	
	YES = RF6260	NO = RF6250

STATEMENT NUMBER	
RF6250	Problem is U9C, U8C, U11C, or U6A. When repaired, refer to TTP RF1000.
RF6260	Is the signal at U6A-13 toggling? YES = RF6280 NO = RF6270
RF6270	Problem is U11C, U6A, or U9C. When repaired, refer to TTP RF1000.
RF6280	Is the signal DAVLP (U6A-9) toggling? YES = RF6300 NO = RF6290
RF6290	Problem is U6A or U8A. When repaired, refer to TTP RF1000.
RF6300	The data extractors are working correctly. Return to the TTP that sent you here.
RF7100	In this section the read multiplexer circuitry will be checked. The read multiplexer logic is located on page 9 of the multi-page schematic. Load the good tape and select Service Aid 23 for 25 ips operation. Are all eight DAVL signals a 45.0 ±7.5 kHz clock? DAVL0, U7C-4 DAVL1, U7C-3 DAVL2, U7C-2 DAVL3, U7C-1 DAVL4, U7C-15 DAVL5, U7C-14 DAVL6, U7C-13 DAVL7, U7C-12 YES = RF7110 NO = RF7105
RF7105	Troubleshoot the failing channel starting at RF6100.
RF7110	Is the signal at U7C-5 toggling? YES = RF7140 NO = RF7120
RF7120	Are the signals at U7C-9, -10, and -11 all toggling? YES = RF7130 NO = RF5000
RF7130	Problem is U7C or U9E. When repaired and U7C-5 is toggling, refer to TTP RF1000.

STATEMENT NUMBER		
RF7140	Are all eight DATA signals toggling? To determine this, check the following locations:	
	DATA0, U10F-4 DATA2, U10F-2 DATA4, U10F-15 DATA6, U10F-13	DATA1, U10F-3 DATA3, U10F-1 DATA5, U10F-14 DATA7, U10F-12
	YES = RF7150	NO = RF7105
RF7150	Is the signal at U10F-5 toggling?	
	YES = RF7170	NO = RF7160
RF7160	Problem is U10F or U9E. When repaired and U10F-5 is toggling, refer to TTP RF1000.	
RF7170	Are all eight CHDROP signals toggling? To determine this, check the following locations:	
	CHDROP0, U10G-4 CHDROP2, U10G-2 CHDROP4, U10G-15 CHDROP6, U10G-13	CHDROP1, U10G-3 CHDROP3, U10G-1 CHDROP5, U10G-14 CHDROP7, U10G-12
	YES = RF7180	NO = RF7105
RF7180	Is U10G-5 toggling?	
	YES = RF7200	NO = RF7190
RF7190	Problem is U10G or U9E. When repaired and U10G-5 is toggling, refer to TTP RF1000.	
RF7200	Are the signals DAVLP (U9E-3) and DATAP (U9E-13) both a 45.0 ±7.5 kHz clock?	
	YES = RF7201	NO = RF7105
RF7201	Is the signal at U9E-10 toggling?	
	YES = RF7210	NO = RF7105
RF7210	Is the signal PSEL (U9E-1) toggling?	
	YES = RF7220	NO = RF5000
RF7220	Is the signal CHDROPX (U9E-9) toggling?	
	YES = RF7240	NO = RF7230

STATEMENT NUMBER	
RF7230	Problem is U9E or one of the destination IC's U9G, U10V, U11F, or U11V. When repaired, refer to TTP RF1000.
RF7240	Is the signal DATAOX (U9E-12) toggling? YES = RF7260 NO = RF7250
RF7250	Problem is U9E or U9G. When repaired and U9E-12 is toggling, refer to TTP RF1000.
RF7260	Is the signal DAVLX (U9E-4) toggling? YES = RF7280 NO = RF7270
RF7270	Problem is U9E or U9G. When repaired and U9E-4 is toggling, refer to TTP RF1000.
RF7280	The read multiplexers are working correctly; return to the troubleshooting routine that sent you here.
RF7300	In this TTP the skew buffer circuitry will be checked. The skew buffer logic is located on page 9 of the multi-page schematic. Because of the complexities to effectively troubleshoot the skew buffer, a logic analyzer must be used. However, due to the unavailability of a logic analyzer, the following procedure provides a recommended sequence to replace the IC's used in the skew buffer without troubleshooting the circuit. Replace U9G and U7G. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7310
RF7310	Replace U9F, U8F, U8E, and U7F. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7320
RF7320	Replace U6F and U6G. Using the system program that detected the failure, have the symptoms changed? YES = RF1000 NO = RF7330
RF7330	If the failure still occurs, we are unable to determine the cause. Return to the troubleshooting routine that sent you here.

STATEMENT NUMBER	
RF7500	In this section the error detect and postamble checking circuitry will be checked. This logic is located on page 9 of the multi-page schematic. Load a scratch tape that is write-enabled. Using a jumper wire, ground U12W-5, then select Service Aid 23 for 25 ips operation. Is the signal STRBX (U17T -12) toggling? YES = RF7510 NO = RF7600
RF7510	Is the signal DCLK (U5F-8) toggling? YES = RF7520 NO = RF7620
RF7520	Is the signal CDATX (U11F-8) toggling? YES = RF7530 NO = RF7640
RF7530	Is the signal DROPI (U9V-13) toggling? YES = RF7540 NO = RF7660
RF7540	Is the signal at U9V-10 toggling? YES = RF7550 NO = RF7670
RF7550	Is the signal FERR (U1J-3) toggling? YES = RF7560 NO = RF7680
RF7560	Are the signals at U18T-12 and U18T-13 toggling? YES = RF7570 NO = RF7690
RF7570	Is the signal at U18T-11 always high? YES = RF7580 NO = RF7700
RF7580	Is the signal at U10V-11 toggling? YES = RF7590 NO = RF7720
RF7590	The error detect and postamble checking circuitry are working correctly. Return to troubleshooting routine that sent you here.
RF7600	Is the signal POSTCHR (U10V-2) and PSEL (U10V-1) toggling? YES = RF7610 NO = RF7300

STATEMENT NUMBER	
RF7610	Problem is U10V, U11V, U17T, or one of the destination IC's U12V, U1J, U14V, U15V, U2J, or U17W. When repaired, refer to TTP RF1000.
RF7620	Is the signal DOUT (U5F-10) toggling? YES = RF7630 NO = RF7300
RF7630	Problem is U5F, U3J, or one of the destination IC's U19X, U19W, or U17W. When repaired and U5F-8 is toggling, refer to TTP RF1000.
RF7640	Is the signal at U11F-9 toggling? YES = RF7650 NO = RF7300
RF7650	Problem is U11F, U19V, or U19X. When repaired and U11F-8 is toggling, refer to TTP RF1000.
RF7660	Is CHDROPX (U10V-13) toggling? YES = RF7670 NO = RF7100
RF7670	Problem is U11V, U12V, U10V, U9V, or U3J. When repaired, refer to TTP RF1000.
RF7680	Problem is U1J, U2J, or U3J. When repaired, refer to TTP RF1000.
RF7690	Is the signal U15V-1 toggling? YES = RF7700 NO = RF7710
RF7700	Problem is U14V, U15V, U13V, U18T, or U17T. When repaired, refer to TTP RF1000.
RF7710	Problem is U12V, U14V, U15V, or U1J. When repaired, refer to TTP RF1000.
RF7720	Problem is U10V, U11V, U12V. When repaired, refer to TTP RF1000.

TEST POINT	SCHEMATIC SHEET	PWB LOCATION	MNEMONIC OR (SIGNAL DESCRIPTION)
0	4	B1	(Positive Servo Rail, Switched)
1	5	A5	Ground
2	8	A5	(CH3 Read Data Transition Pulse)
3	8	A5	DCLK1
4	8	A5	(CHP Read Data Transition Pulse)
5	8	A5	(CH5 Read Data Transition Pulse)
6	4	B5	(Take-up Servo Drivers Input)
7	8	A5	(CH0 Read Data Transition Pulse)
8	8	A5	(CH6 Read Data Transition Pulse)
9	8	A5	(CH4 Read Data Transition Pulse)
10	8	A5	DCLK2
11	8	A5	(CH7 Read Data Transition Pulse)
12	4	B5	(Supply Servo Drivers Input)
13	4	E1	SMDH
14	4	E1	TMDH
15	5	F1	(K1 Voltage)
16	4	D5	(Take-up Error Signal)
17	4	D5	VTN4
18	4	D5	(Supply Back EMF)
19	4	D5	VIN3
20	4	E5	(Servo Position Sensor Error Voltage)
21	5	D5	Ground
22	4	D5	(Take-up Current Limit Input)
23	4	D5	VIN6
24	4	D5	(Supply Current Limit Input)
25	4	D5	(Supply Error Signal)
26	5	A10	Ground
27	8	G11	CHDROP 0
28	8	G11	CHDROP 2
29	8	G11	CHDROP 3
30	8	G11	CHDROP P
31	8	G11	CHDROP 6
32	8	G11	CHDROP 1
33	8	G11	CHDROP 5
34	8	H11	CHDROP 4
35	8	H11	CHDROP 7
36	5	H11	Ground
37	5	I1	Ground
38	5	A18	Ground
39	7	A18	(CH4 Read Input)
40	7	B17	(CH4 Read Level)
41	7	B18	(CH6 Read Input)
42	7	C17	(CH6 Read Level)
43	7	C18	(CH0 Read Input)
44	7	D17	(CH0 Read Level)
45	7	D18	(CH1 Read Input)
46	7	D17	(CH1 Read Level)
47	7	E18	(CH2 Read Input)
48	7	F17	(CH2 Read Level)

Table 3-7. Test Point Locations

TEST POINT	SCHEMATIC SHEET	PWB LOCATION	MNEMONIC OR (SIGNAL DESCRIPTION)
49	7	F18	(CHP Read Input)
50	7	F17	(CHP Read Level)
51	7	F18	(CH3 Read Input)
52	7	G17	(CH3 Read Level)
53	7	G18	(CH7 Read Input)
54	7	H17	(CH7 Read Level)
55	7	H18	(CH5 Read Input)
56	7	H17	(CH5 Read Level)
57	7	A14	RNOISE
58	5	L2	$\overline{\text{RES}}$
59	5	L2	Ground
60	3	M4	(DAC MUX Output Inhibit)
61	4	R1	(Negative Servo Rail, Switched)
62	2	R7	CLK8M
63	5	N19	+5R
64	5	N19	VIN2
65	5	N19	(Servo Position Sensor Modulated Output)
66	5	N19	Ground
67	5	P19	(Servo Speed Prescaler Load Input)
68	5	P19	(Servo Position Sensor Modulating Input)
69	5	R19	P2A0 (Tape-In-Path Sensor)
70	5	R19	B0
71	5	R19	P2A1 (File Protect/Reel Tip Sensor)
72	5	R19	A0
73	5	R19	(Servo Speed Prescaler Enable Input)
74	5	V20	Hub Lock
75	5	V20	Door Lock
76	5	T3	Ground
77	3	T3	POARDY
78	3	T4	(Load Point Status)
79	3	T4	FSEL
80	3	T5	(Ready Status Gate Enable)
81	3	T5	(On-line Status)
82	3	T6	(Transport Ready Status)
83	3	T6	(File Protect Status)
84	3	T7	(Formatter Busy Status)
85	3	T8	(End of Tape Status)
86	3	T8	(Data Busy Status)
87	3	T9	(Rewinding Status)
88	5	T7	Ground
89	5	T1	+5V
90	5	X1	-12V
91	5	X1	Ground
92	5	X1	+12V
93	9	G1	PECLK
94	7	A12	VCOM
95	5	L16	Ground
96	5	I17	Ground
97	7	A17	VCOM

Table 3-7. Test Point Locations (continued)

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SECTION IV

MAINTENANCE

GENERAL

4-1. This section contains periodic maintenance information and adjustment procedures. Table 4-1 presents the preventive maintenance schedule.

MTSU POSITIONS FOR SERVICING

CAUTION

When MTSU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of MTSU in extended position could upset an inadequately anchored equipment rack.

4-2. **Operator Maintenance Access (See Figure 4-1).** To gain access to the tape path area for routine cleaning, proceed as follows:

a. Switch MTSU power off.

b. Withdraw drive on its slides until locks engage.

c. Open top cover by lifting sides directly behind front panel. Place cover stay in slot provided.

d. Perform required maintenance.

e. To return drive to operating position, close top cover.

f. Release slide locks and push unit back into equipment rack.

g. Switch MSTU power on.

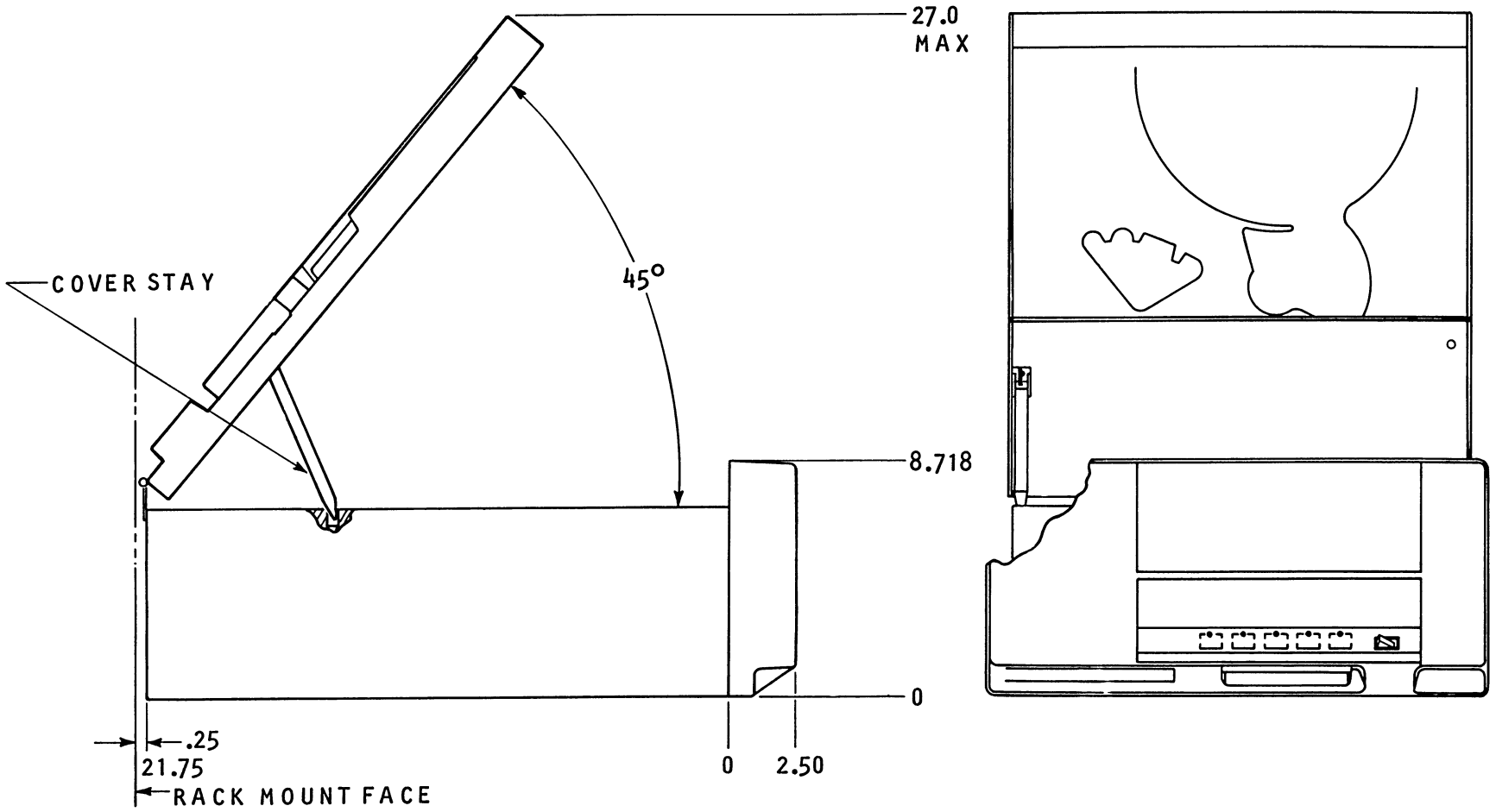

Figure 4-1. Operator Maintenance Access Position

4-3. **Service Access (See Figure 4-2).** To gain access to the main PWB and other internal components, proceed as follows:

a. Switch MTSU power off.

b. Place drive in operator maintenance access position. (Refer to paragraph 4-2).

c. Using a screwdriver, loosen two captive screws located at front sides of top plate casting.

d. Close top cover.

e. Grasping two lower corners of front panel, lift front panel to its maximum upright position. Lower slowly (about one inch) until the top plate support latch engages.

f. Insert the safety pin provided through both holes in the top plate support.

g. Perform required maintenance.

h. To return drive to operating position, remove the safety pin.

i. Lift front panel to its maximum upright position and lower smoothly to horizontal position.

j. Reverse steps a through d.

OPERATOR PREVENTIVE MAINTENANCE

4-4. For routine cleaning, place the MTSU in the operator maintenance access position. Figure 4-3 identifies by number the locations of items that require routine cleaning. The recommended cleaning materials are:

a. 1 8 oz. Can Tape Drive Cleaner (Freon TF)

b. 50 Solvent Resistant Swabs

c. 50 Lint-Free, Non-Abrasive Cloths

d. Plastic Cleaner - (Miller Stephenson Chemical Co., MS260, Windex, or equivalent commercial grade plastic cleaner).

NOTE

Items a through c are available as Cipher Part No. 960855-001, Tape Drive Cleaning Kit.

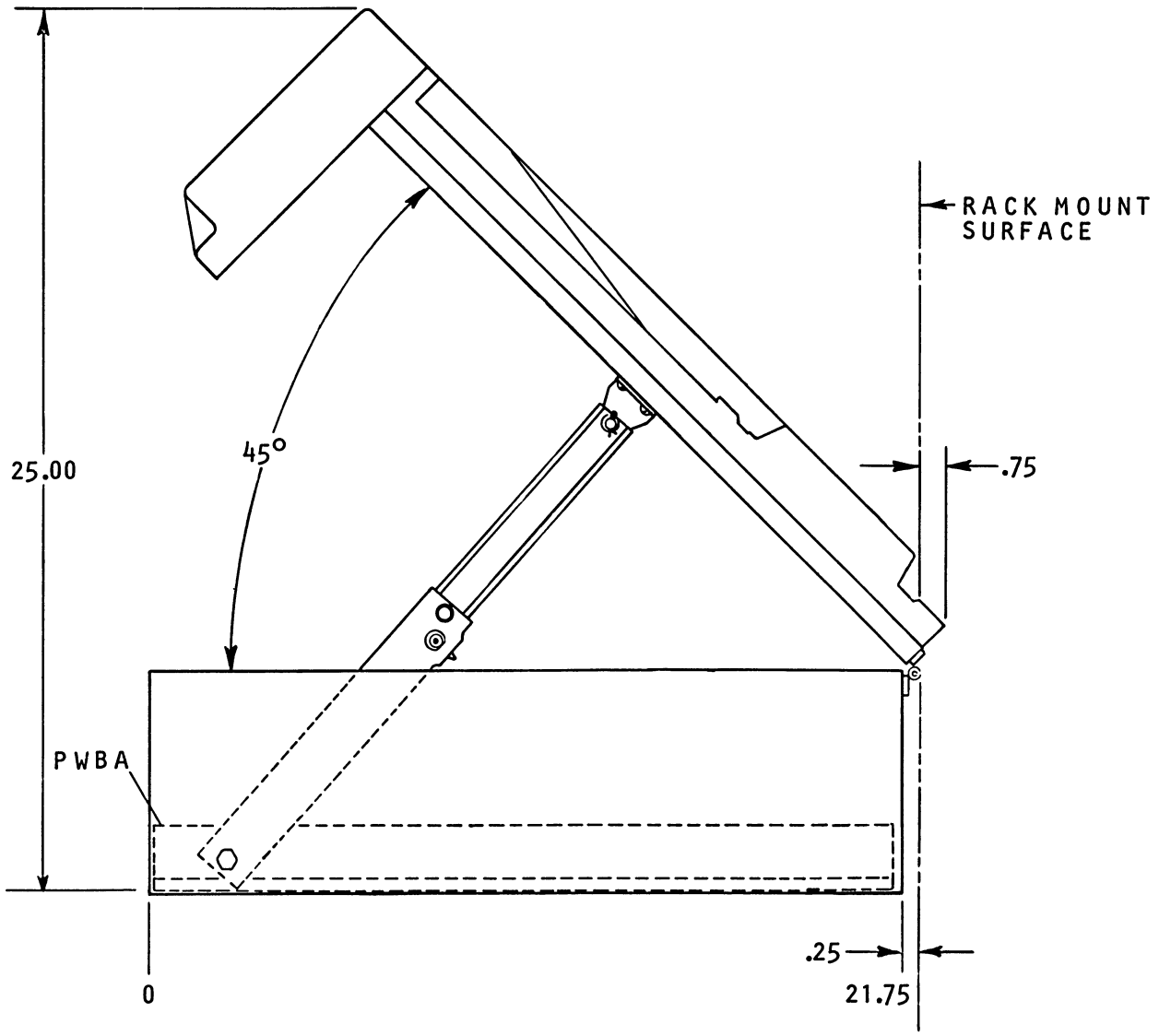

Figure 4-2. Service Access Position

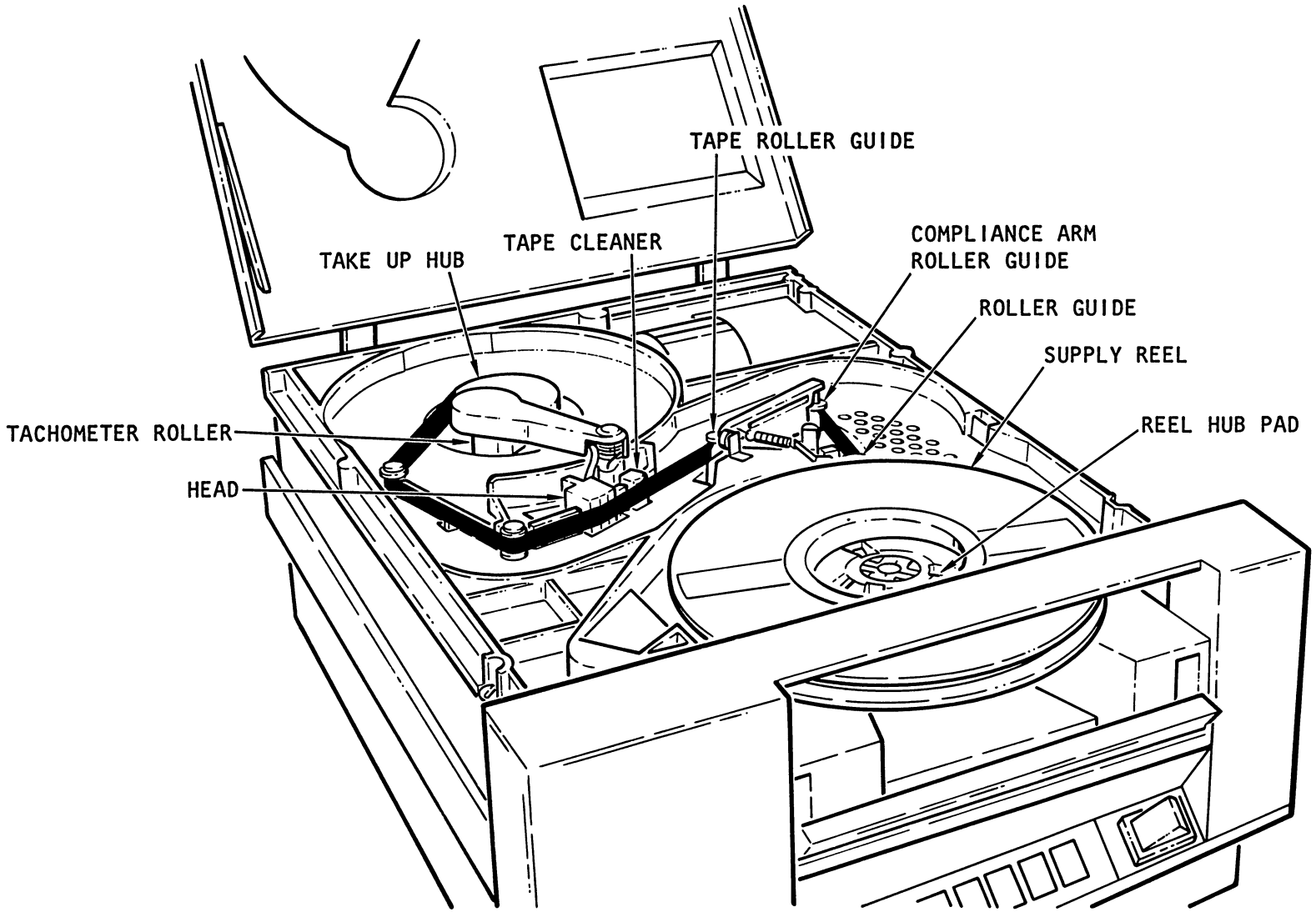

Figure 4-3. Tape Path and Related Parts

MAINTENANCE OPERATION	FREQUENCY (HOURS)	QUANTITY TO MAINTAIN	PROCEDURE PARAGRAPH
Operator			
Tachometer Roller	40*	1	4-5
Take Up Hub	"	1	4-6
Roller Guides	"	5	4-7
Reel Hub Pads	"	3	4-8
Head	20*	1	4-9
Tape Cleaner	40*	1	4-10
Front Panel and Door	As Required	1	4-11
Top Plate Casting	As Required	1	4-12
Filter	1000	1	4-13
Service Technician			
Replace Reel Motors	5000	2	4-40 4-44

*The above frequency schedule should be observed or performed weekly, whichever is sooner.

Table 4-1. Preventive Maintenance Schedule

CAUTION

Do not apply a cleaner directly from the container to the surface to be cleaned, even though instructions on the container may indicate to do so. Always apply the cleaner to a swab or wipe first, carefully removing any excess. The tachometer roller and roller guides contain precision bearings. Solvents allowed to run into the bearings will break down the lubricant.

4-5. **Tachometer Roller (8, Figure 4-3).** Use a swab moistened with tape drive cleaner. Gently wipe the entire roller surface. The roller can be rotated by manually turning the take-up hub slowly.

4-6. **Take-Up Hub (9, Figure 4-3).** Use a swab or cloth moistened with tape drive cleaner. Rotate the hub manually while gently wiping the tape wrapping surface.

4-7. **Roller Guides (3, 4 and 5, Figure 4-3).** Use a swab moistened with tape drive cleaner. Rotate each roller and gently wipe the tape contact surface and flanges or washers.

4-8. **Reel Hub Pads (1, Figure 4-3).** Use a swab or cloth moistened with tape drive cleaner. Wipe the contact surface of each pad and remove any debris around the pad.

4-9. **Head (7, Figure 4-3).** Use a swab or cloth moistened with tape drive cleaner. Wipe the entire face of the head and attached erase bar, paying particular attention to the recessed areas.

CAUTION

Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors.

4-10. **Tape Cleaner (6, Figure 4-3).** Use a swab moistened with tape drive cleaner. Wipe each blade along its length. Remove accumulated oxides from the recessed area between the blades.

CAUTION

Exercise care to avoid damage to sharp edges of tape cleaner blades.

4-11. **Front Panel and Door.** Use a cloth moistened with plastic cleaner.

4-12. **Top Plate Casting.** Use a cloth moistened with plastic cleaner. Referring to Figure 4-3, wipe away the oxide dust in the tape path area. Be careful not to get dirt on the head, rollers, etc. Avoid disturbing the sensors.

4-13. **Filter.** Locate and remove the filter from inside the air duct opening at the lower left of the front panel. See Figure 4-4. Clean the filter with low pressure compressed air, or vacuum, in the opposite direction of airflow and reinstall.

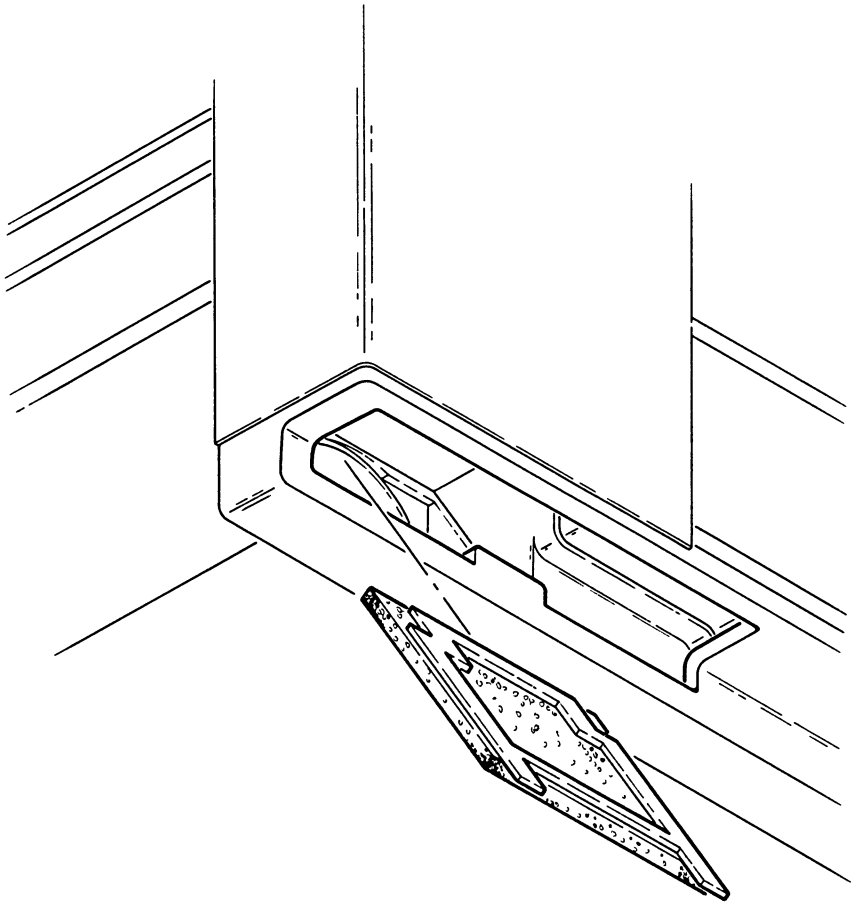

Figure 4-4. Air Filter Removal

SERVICE TECHNICIAN PREVENTIVE MAINTENANCE

4-14. **Reel Motors.** Replace both reel motors after 5000 hours of unit operation. Refer to paragraphs 4-40 and 4-44 for removal/replacement instructions.

4-15. **Fuse Removal and Replacement.** To replace the fuse, proceed as follows:

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

a. Remove power cord from outlet.

b. Place the drive in service access position. Refer to paragrpah 4-3.

c. Locate fuse cap on power supply housing. Push and twist cap to remove.

d. For 100-120 volt operation, use a 3-ampere, slo-blo, 250V type fuse.

e. For 208-240 volt operation, use a 1-1/2 ampere, slo-blo, 250V type fuse.

f. Reverse steps a through c.

4-16. **Read Threshold Adjustment.** Adjustment of the read threshold level is required only when the head or main PWB is changed. Adjust read threshold as follows:

a. Place drive in service access position. Refer to paragraph 4-3.

b. Apply power to unit.

c. Load tape (write-enable ring must be installed).

NOTE

Use a National Bureau of Standards Reference Level Tape, or a certified tape that produces comparable read levels when compared with a National Bureau of Standards tape for this adjustment.

d. Activate Service Aid 21. Refer to paragraphs 3-3 and 3-26.

e. Shield the LED indicators on the front panel from ambient light so that an accurate indication of ON, OFF or FLASHING can be observed.

f. Note the indication of the front panel LED's before attempting any adjustment.

g. If LOAD and UNLOAD indicators flash intermittently, NO ADJUSTMENT IS REQUIRED. Refer to step i.

h. If the LOAD and UNLOAD indicators are not flashing intermittently, adjust R115 for the indication in step g. R115 may require several turns (in either direction) to find the correct adjustment point. If the correct adjustment point cannot be found, a fault in (a) making the adjustment, (b) the head assembly, or (c) main PWB is indicated.

i. Exit Service Aid 21.

NOTE

This adjustment is based on the amplitude characteristics of the tape used for the adjustment. Other tapes whose amplitude characteristics are different may not provide the same indication after the adjustment. This fact simply reflects the difference in tapes and is not a fault condition. The tolerance range of the adjustment takes into account the inherent differences between tapes that otherwise meet the ANSI X 3.40-1976 criteria.

j. Reverse steps a through c.

REPAIR AND REPLACEMENT OF PARTS AND COMPONENTS

4-17. The MTSU is designed to operate over long periods of time without requiring corrective maintenance of any kind. Spare parts are available for replacement of parts and subassemblies which may have become damaged or worn through extremely long and/or hard usage. This section presents instructions for removal of defective parts and subassemblies, disassembly, assembly, and adjustment instructions where applicable, and a list of the required tools and special parts, Table 4-2.

4-18. Except as noted, subassemblies and parts which can be removed from above the top plate are indexed in Figure 4-5, while those which can be removed from beneath the top plate are indexed in Figure 4-6. Refer to the respective key lists of these figures for the names of the subassemblies and parts indexed on each. These lists also contain the figure numbers of the detail drawings, presented in this section, in which removal and/or disassembly of these subassemblies and parts are illustrated.

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

FRONT PANEL ASSEMBLY (1, Figure 4-5).

4-19. **Power Switch Replacement.** To replace the power switch (1, Figure 4-7) proceed as follows:

a. Remove power cord from outlet.

b. Position transport in service access position in accordance with instructions in paragraph 4-3.

c. Remove wire connectors from terminals of power switch in back of front panel, identifying each terminal as to the switch terminal from which it was removed.

d. Bend in tabs holding switch to panel, and push out of panel from back.

e. Place replacement switch in front panel, bend tabs in back of switch as necessary to fit tightly in panel, and reconnect wires as identified in step c.

f. Restore transport to operating position.

ITEM	DESCRIPTION	CIPHER P/N
1	Hub height adjustment tool	760105-545
2	Skew monitor (IC clip assy.)	960067-001
3	Spring scale (for tension arm), 0-36 oz	
	John Chatillon & Sons 83-30 Kew Gardens Rd. Kew Gardens, NY 11415	Chatillon P/N LP36
4	Tape end cutter/crimper	209990-500
5	Vibratight (for adjustment screws)	209990-075
6	Torque seal (for screw heads)	209994-025
7	Loctite -222- adhesive	209990-072
8	Loctite 242	209990-074
9	Loctite -601- fast retaining compound	209990-076
10	Permabond - sealer (air duct)	209990-107
11	Lubriplate - bearing lubricant	210444
12	Master Skew tape (IBM)	799019-401
13	Tracking tape	
	Pericomp Corp. 14 Huron Dr. Natick, MA 01760	970039-001

Table 4-2. Repair and Maintenance Tool/Parts List

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-5	MODEL F880 TAPE TRANSPORT (Top View)	REF	
-1	FRONT PANEL ASSEMBLY	4-7	4-21
-2	SUPPLY HUB ASSEMBLY	4-8	4-23
-3	HEAD ASSEMBLY.....	4-10	4-24
-4	ROLLER GUIDE ASSEMBLY.....	4-11	4-25
-5	EOT/BOT SENSOR ASSEMBLY.....	4-12	4-26
-6	TACHOMETER ASSEMBLY.....	4-13	4-27
-7	COVER ASSEMBLY	4-14	4-28
-8	TAKEUP HUB ASSEMBLY.....	4-15	4-29
-9	COMPLIANCE ARM ASSEMBLY	4-17	4-30
-10	TAPE-IN-PATH SENSOR, TRANSMITTER	4-18	4-32
-11	TAPE-IN-PATH SENSOR, RECEIVER	4-19	4-33
-12	COMPLIANCE ARM BUMPER ASSEMBLY.....	4-20	4-34
-13	ROLLER TAPE GUIDE ASSEMBLY (Solid)	4-21	4-35
-14	FILE-PROTECT SENSOR.....	4-22	4-36

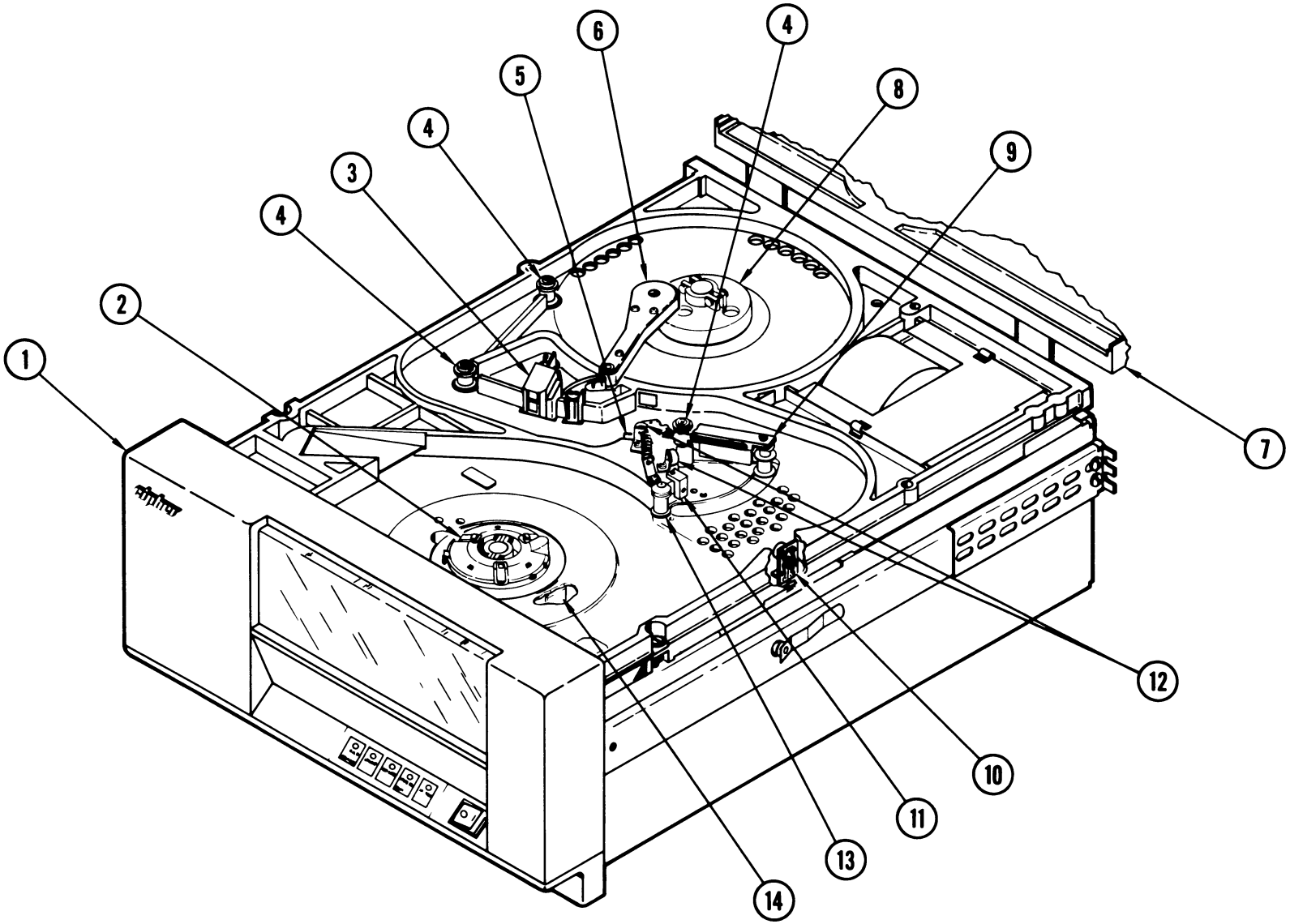

Figure 4-5. Model F880 Tape Transport (Top View)

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-6	MODEL F880 TAPE TRANSPORT (Bottom View) ..	REF	
-1	DRIVE MAIN PWB ASSEMBLY	4-23	4-37
-2	POWER SUPPLY ASSEMBLY	4-24	4-38
-3	POWER SUPPLY PWB	4-25	4-39
-4	TAKEUP MOTOR ASSEMBLY.....	4-26	4-40
-5	AIR DUCT, top-plate	4-27	4-41
-6	AIR DUCT, front panel	4-27	4-42
-7	TUBE, air intake	4-27	4-41
-8	SUPPLY MOTOR ASSEMBLY	4-28	4-44
-9	AIR CAPACITOR ASSEMBLY.....	4-17	4-30
-10	HUB LOCK ASSEMBLY	4-29	4-45
-11	DOOR LOCK ASSEMBLY	4-30	4-48
-12	TRANSFORMER ASSEMBLY	4-31	4-49

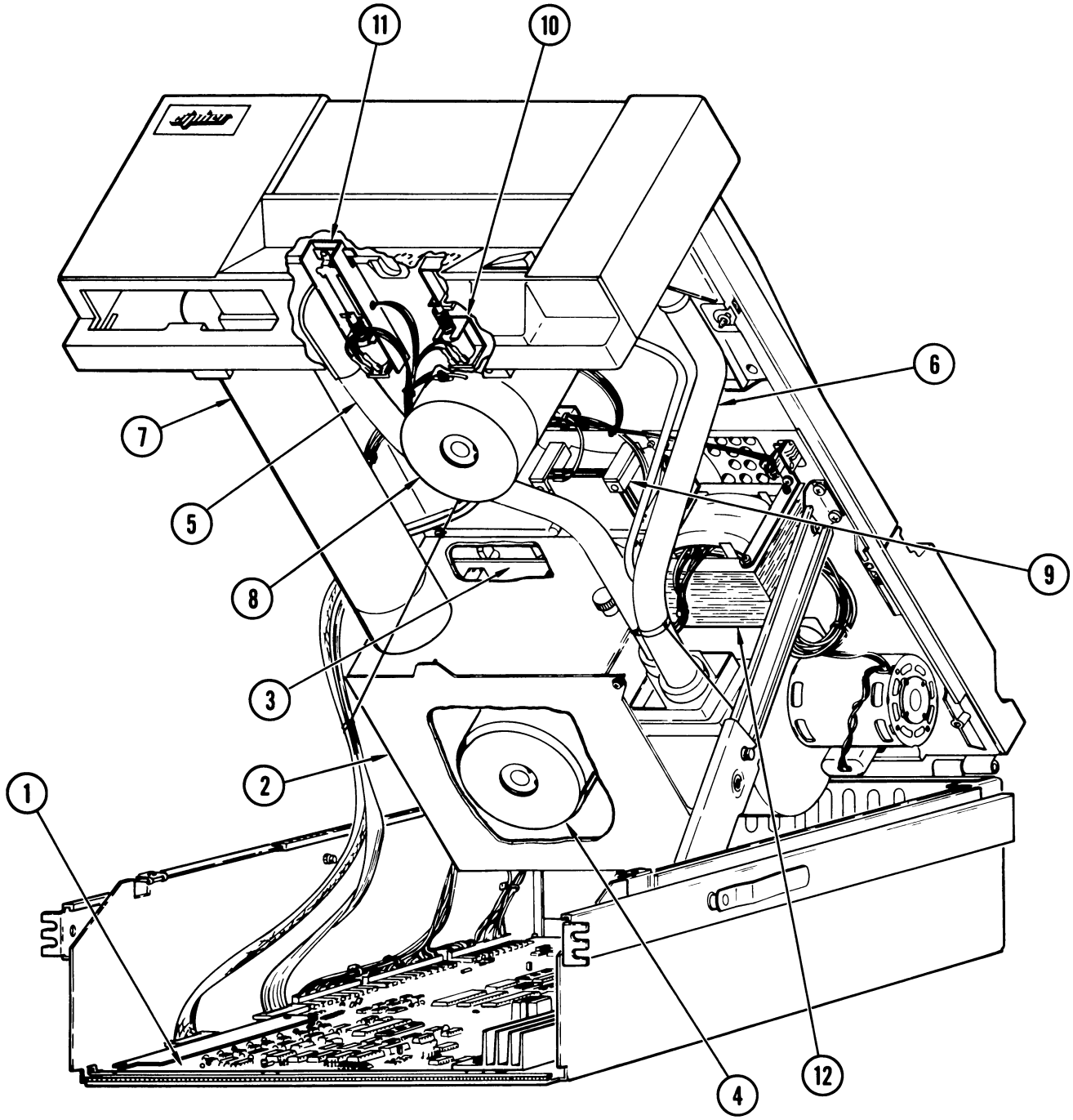

Figure 4-6. Model F880 Tape Transport (Bottom View)

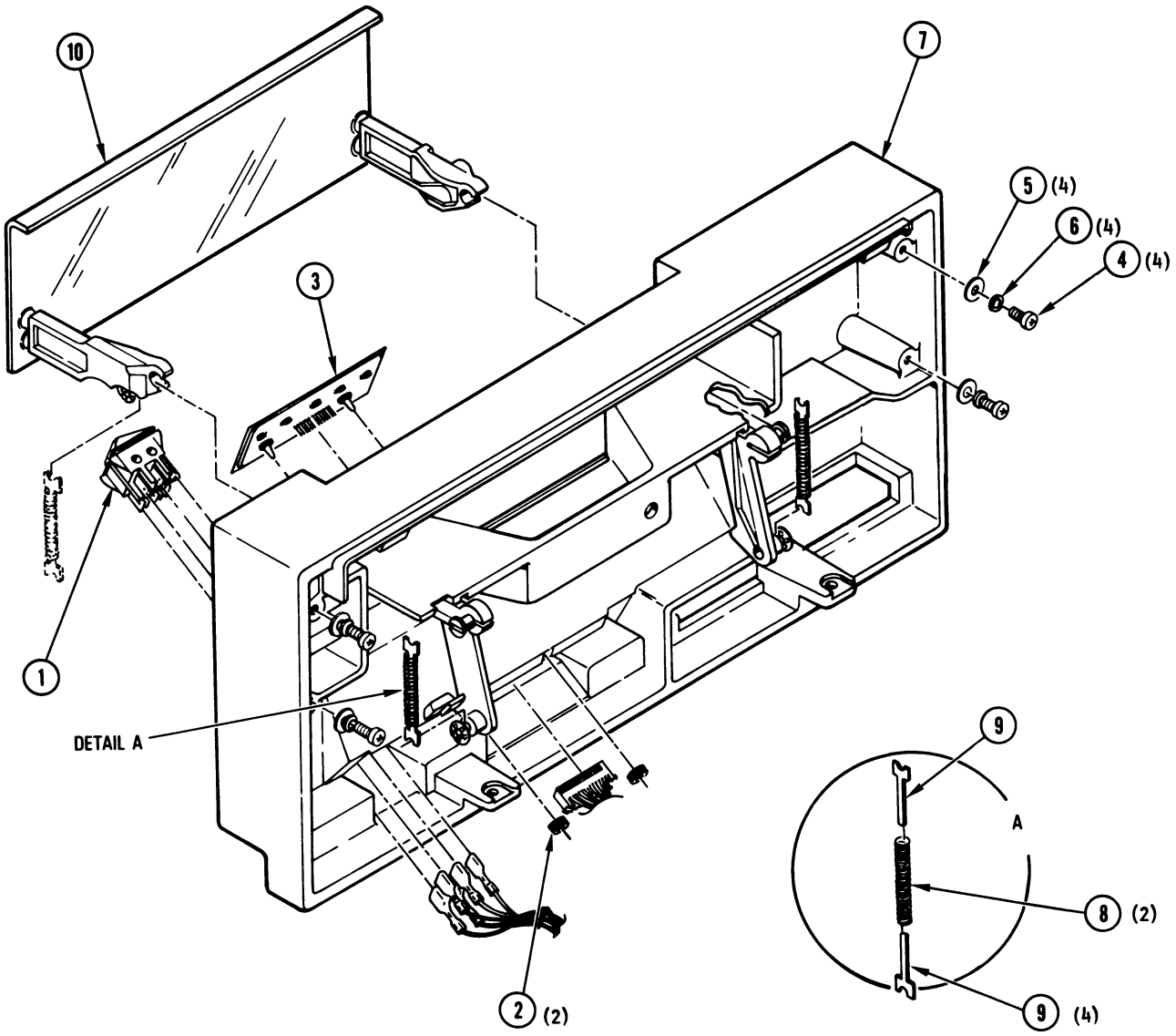

Figure 4-7. Front Panel Assembly

4-20. **Touch Switch Replacement.** To replace the touch switch (3, Figure 4-7), proceed as follows:

a. Position transport in service access position, in accordance with instructions in paragraph 4-3.

b. Remove connector from switch in back of front panel, noting position of connector.

c. Remove grommets (2) from attachment posts of switch (3) and lift switch out of front panel.

d. Insert replacement switch in front panel, place grommets (2) on attachment posts, pressing down tightly against panel, and secure using Permabond.

e. Attach switch connector at back in same position as removed in step b (brown wire nearest power switch).

f. Restore transport to operating position.

4-21. **Front Panel Subassembly Replacement.** To replace the front-panel subassembly (7, Figure 4-7), proceed as follows:

NOTE

For purposes of this procedure, it is assumed that power switch (1), touch switch (3), and door assembly (10) are to be removed from discarded front panel subassembly and reused in replacement. If one or more of these items is also to be replaced, disregard instructions for removal of such items in this paragraph.

a. Position transport in service access position, in accordance with instructions in paragraph 4-3.

b. Open front-panel door (10).

c. Remove four screws (4), lockwashers (5), and flat washers (6). Remove switch wire terminals and connectors attached to switches (1 and 3), noting position of each. Lift off entire front panel assembly.

NOTE

If air intake tube comes off with front panel, remove from front panel and set aside for reassembly.

d. Remove following parts and subassemblies from discarded front-panel subassembly (7) and replace in replacement front panel subassembly as follows:

(1) Power switch: refer to paragraph 4-19.

(2) Touch switch: refer to paragraph 4-20.

(3) Door assembly: refer to paragraph 4-22.

e. If air intake tube came off with front panel replace in front panel.

f. Attach complete front panel assembly to top plate with screws, washers, and lockwashers removed in step c. Ensure that gooseneck of front panel air duct is properly positioned (paragraph 4-42, step f).

g. Reconnect wires and connectors as identified in step c.

h. Restore transport to operating position.

i. Use Service Aid 32 to test door lock adjustment. Refer to paragrpah 4-48, step j for adjustment procedure.

4-22. **Removal And Replacement of Door Assembly.** To replace the door assembly (10, Figure 4-7), proceed as follows:

a. Remove front panel assembly from top plate in accordance with paragraph 4-21, steps a, b, and c.

b. Remove two springs (8) and four guides (9), and push door out of front panel, using finger pressure on back of door from under side of panel.

c. Install door assembly in front panel subassembly by snapping arms onto plastic studs of front panel assembly, as indicated in Figure 4-7.

d. Assemble guides (9) with springs (8), with flat surfaces of guides in contact with each other.

e. Reinstall assembled front panel assembly on top plate in accordance with paragraph 4-21, steps e-i.

f. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

SUPPLY HUB ASSEMBLY (2, Figure 4-5).

4-23. **Removal, Replacement and Adjustment (Figure 4-8).** Place transport in operator maintenance access position in accordance with paragraph 4-2 and proceed as follows:

a. Rotate hub assembly (1, Figure 4-8) so that socket-head screws face front panel door.

b. Open front-panel door and loosen socket-head screws (2).

c. Remove supply hub from reel motor shaft.

d. Install replacement hub on shaft, and position hub height gauge, Cipher Part No. 760105-545, as shown in Figure 4-9 so that it contacts the raised machined surface of the top plate. Raise the supply hub until the reference surface contacts the hub-height tool.

e. Ensuring that hub-height tool is in contact with both the top plate and reel hub, tighten socket-head screws (2).

f. Remove tool, restore transport to operating position, and load tape.

g. Run tape forward and reverse using Service Aid 23, noting tape position on reel for which replacement hub was installed. If tape is centered between sides of reel, adjustment is correct. If not, loosen socket-head screws and repeat steps d through g until positioning is correct.

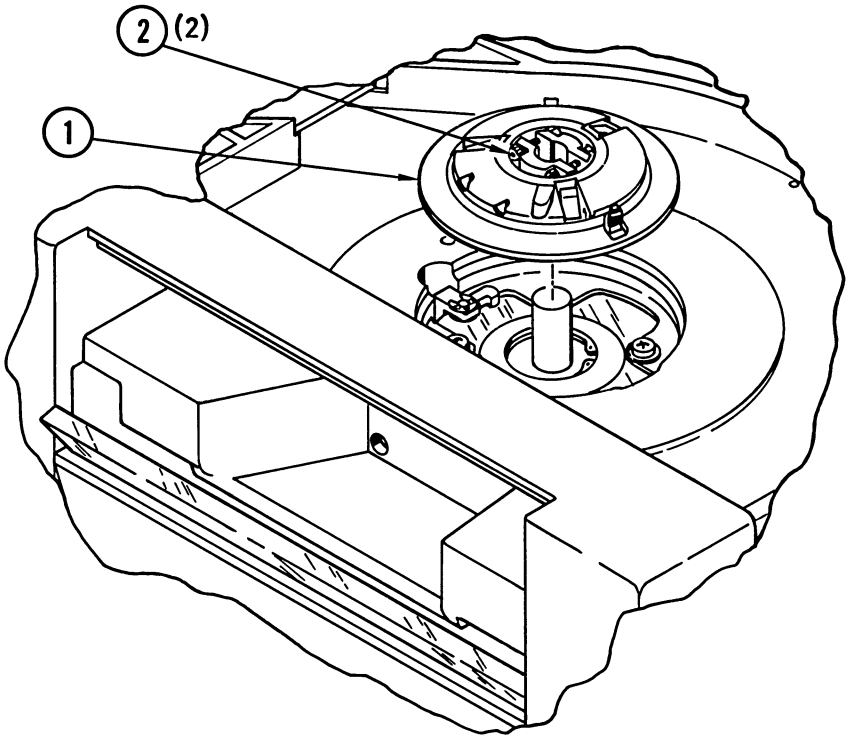

Figure 4-8. Supply Hub Assembly

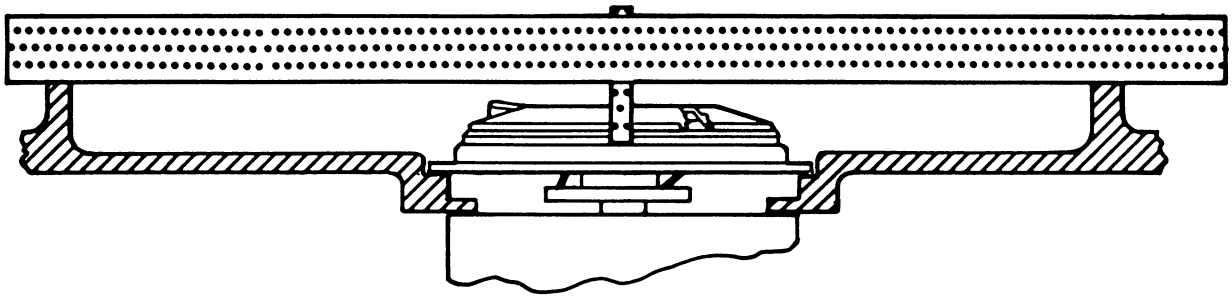

Figure 4-9. Supply Hub Adjustment

HEAD ASSEMBLY (3, Figure 4-5).

4-24. **Removal and Replacement of Assembly and Parts (Figure 4-10).** Place the transport in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

NOTE

It is not necessary to remove complete assembly from top plate in order to remove tape scraper (13, Figure 4-10). Refer to paragaph 4-24, f. If head is defective and in need of replacement, entire head assembly (8), including tape scraper (13) must be replaced.

a. Remove head connectors from P6/P7 on main PWB and remove from cable retractor.

b. Working from under side of top plate, remove center adjustment screw (1), flat washer (2), four screws (3), and lockwashers (4), three flat washers (5), one flat washer (6), and cable clamp (7) supporting assembly (8) with one hand as last screw is removed. Identify wire terminal and cable clamp as to position from which removed, and save attaching parts for reinstallation.

c. Pull assembly (8) and wire harness carefully down through hole in top plate and cables over air intake tube.

d. Install replacement assembly in reverse order of sequence in steps b and c, carefully pushing head and connectors through hole in top plate and attaching wire terminal and cable clamp in positions from which removed. Do not tighten center adjustment screw (1) at this time.

e. Feed head connectors and cables through cable retractor and over air intake tube and install on J6/J7 on main PWB.

f. If tape scraper (13) only is to be replaced, remove two socket-head screws (12), nuts (9), lockwashers (10), and flat washers (11). Save attaching parts for reassembly, and install replacement scraper in reverse order of removal.

g. Adjust tape scraper (13) as follows:

(1) Insert and load a tape.

(2) Loosen socket-head screws (12) and move tape scraper away from tape.

(3) Slowly move tape scraper toward tape until it contacts tape.

(4) Rotate tape scraper until both scraper blades are touching the tape, producing two vertical creases in the tape at the points of contact.

(5) Verify that tape is touching erase bar. Check for vertical crease in tape at the point of contact.

(6) Tighten socket-head screws (12) and reverify that tape is in contact with both blades of tape scraper and the erase bar.

h. Perform tape alignment procedure, paragraph 4-50.

i. Place transport in operating position.

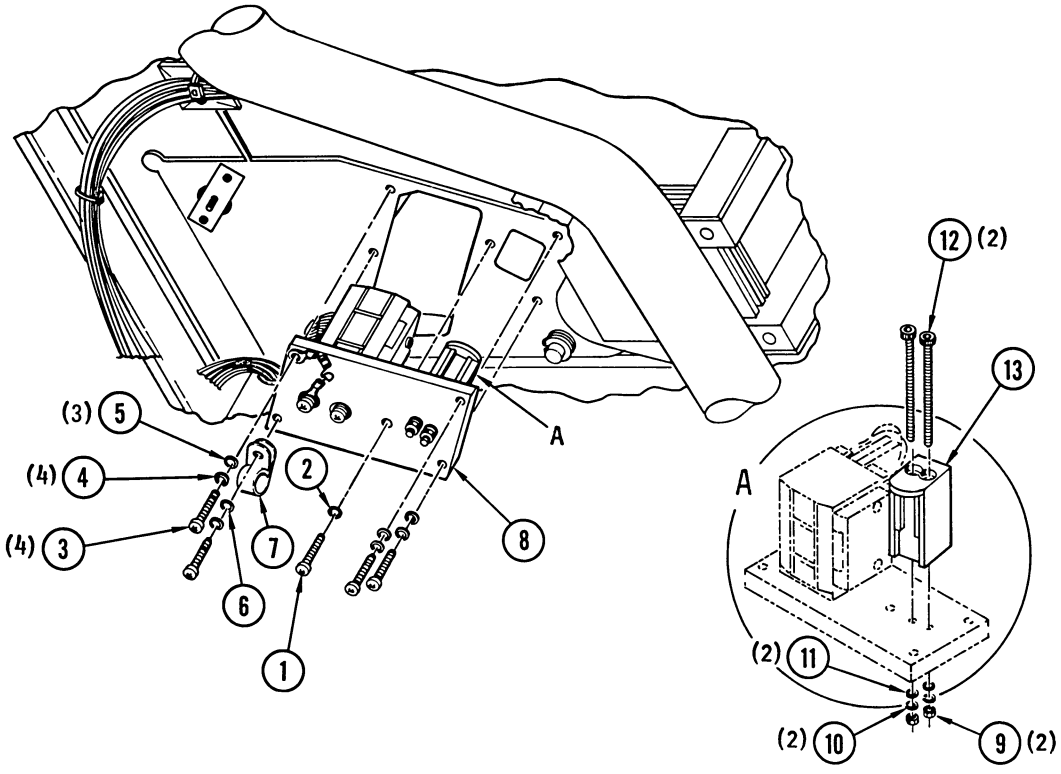

Figure 4-10. Head Assembly

ROLLER GUIDE ASSEMBLY (4, Figure 4-5).

4-25. **Removal and Replacement of Assembly (Figure 4-11).** Place the transport in operator maintenance access position in accordance with instructions in paragraph 4-2 and proceed as follows:

a. Remove attaching screw (1, Figure 4-11), leaving shims (4) and spring (3) in place, remove roller guide assembly through top of top plate, saving attaching parts for reassembly.

b. Install replacement roller guide (2), using original attaching parts.

c. Perform tape alignment procedure, paragraph 4-50.

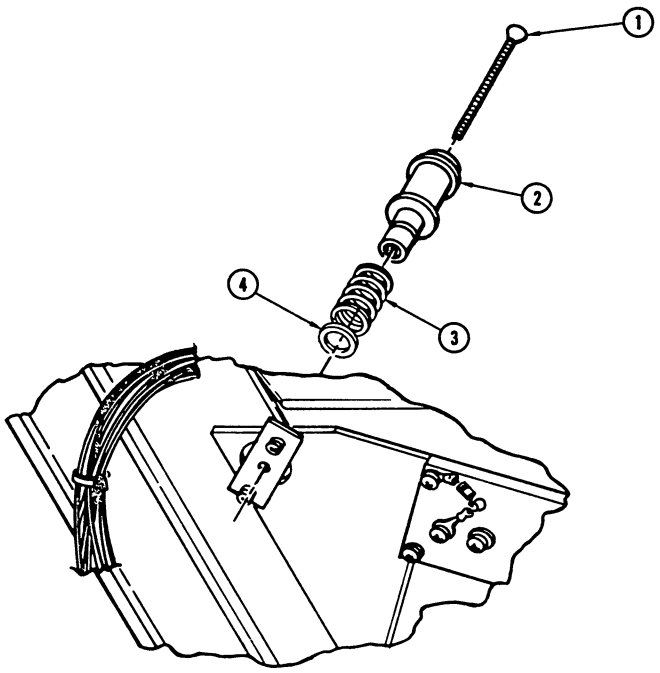

Figure 4-11. Roller Guide Assembly

EOT/BOT SENSOR ASSEMBLY (5, Figure 4-5).

4-26. **Removal and Replacement (Figure 4-12).** Place transport in operator maintenance access position, in accordance with paragraph 4-2, and proceed as follows:

a. Holding compliance arm aside to provide access to mounting screws, remove two screws (1, Figure 4-12) and lock washers (2) and retain for reassembly.

b. Remove EOT/BOT assembly (3), carefully pulling wires and connector (4) through hole in top plate assembly.

c. Unplug EOT/BOT assembly.

CAUTION

To prevent misalignment, avoid contact with sensors mounted on replacement EOT/BOT PWB. Sensors are factory-aligned for optimum output.

d. Attach plug removed in step c.

e. Feed wires and connector (4) carefully through hole in top plate assembly (refer to step b).

f. Attach EOT/BOT assembly loosely with screws (1) and lockwashers (2), position assembly as close to tape as mounting bracket will allow, with PWB parallel to casting wall directly behind it, and tighten screws.

g. Place transport in operating position.

h. Use Service Aids 22 and 23 to test EOT/BOT assembly.

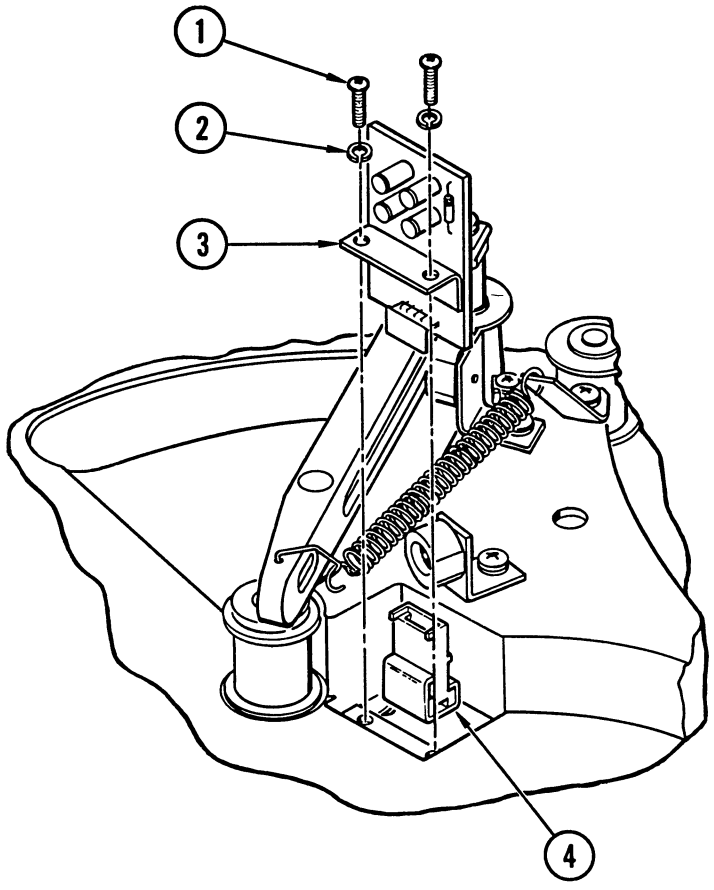

Figure 4-12. EOT/BOT Assembly

TACHOMETER ASSEMBLY (6, Figure 4-5).

4-27. **Removal and Replacement (Figure 4-13).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Disconnect tachometer wiring harness connector from mating connector beneath top plate.

b. Remove grip ring (1, Figure 4-13), wavespring washer (2), and shim(s) (3) from tachometer post beneath top plate and save for reassembly.

c. Remove tachometer assembly (6) from top plate, pulling wire harness and connector carefully through hole.

d. If lower bearing (4) or upper bearing (5) was removed, apply Loctite 601 sparingly to outside surface of replacement bearing before installing.

e. Install replacement tachometer assembly through upper bearing (5) and lower bearing (4), seating end of spring in adjacent small hole in top plate.

f. Install shim(s) (3), wavespring washer (2), and grip ring (1). If necessary, install additional shims (3) to compress wavespring half of its height when grip ring is installed.

g. Push connector and wire harness through top plate hole, and connect beneath top plate.

h. Place transport in operating position.

i. Use Service Aid 11 to test tachometer operation.

COVER ASSEMBLY (7, Figure 4-5).

4-28. **Removal and Replacement of Assembly and/or Parts (Figure 4-14).** Place the transport in operator maintenance access position (paragraph 4-2). Remove damaged cover assembly, subassemblies, and/or parts as necessary in the sequence of index numbers (Figure 4-14) assigned to the item and its attaching parts, saving attaching parts for use during reassembly if necessary, and install the replacement item in reverse sequence of removal. Observe the following special instructions:

a. When replacing catch (10) tighten screws just enough to hold and then try closing cover. If catch is too far forward and prevents cover from closing or is too far back to engage latch on front panel assembly, loosen attaching screws (7) and move catch forward or backward so that the cover closes and catch latches securely on front panel.

b. Restore transport to operating position.

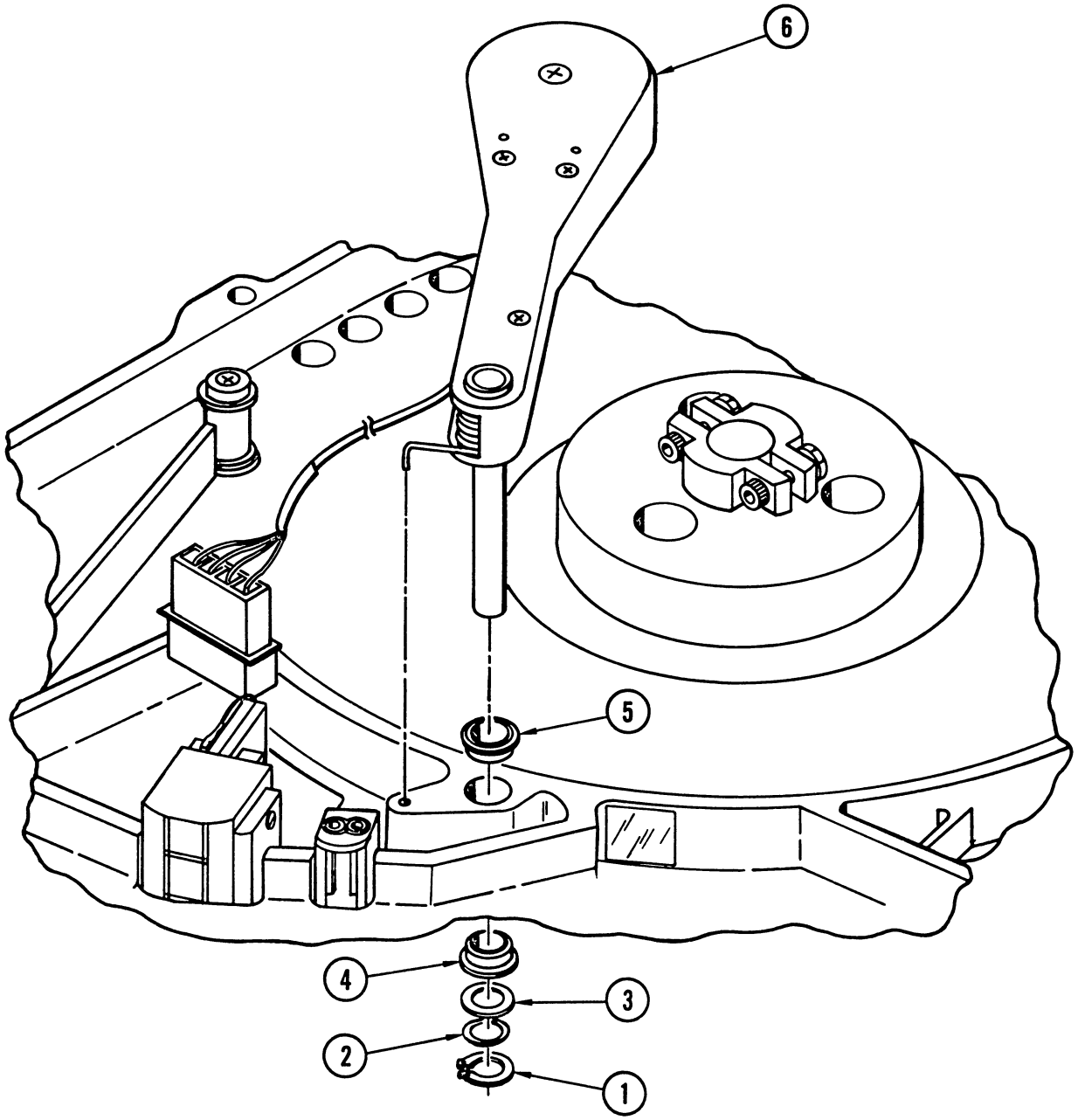

Figure 4-13. Tachometer Assembly

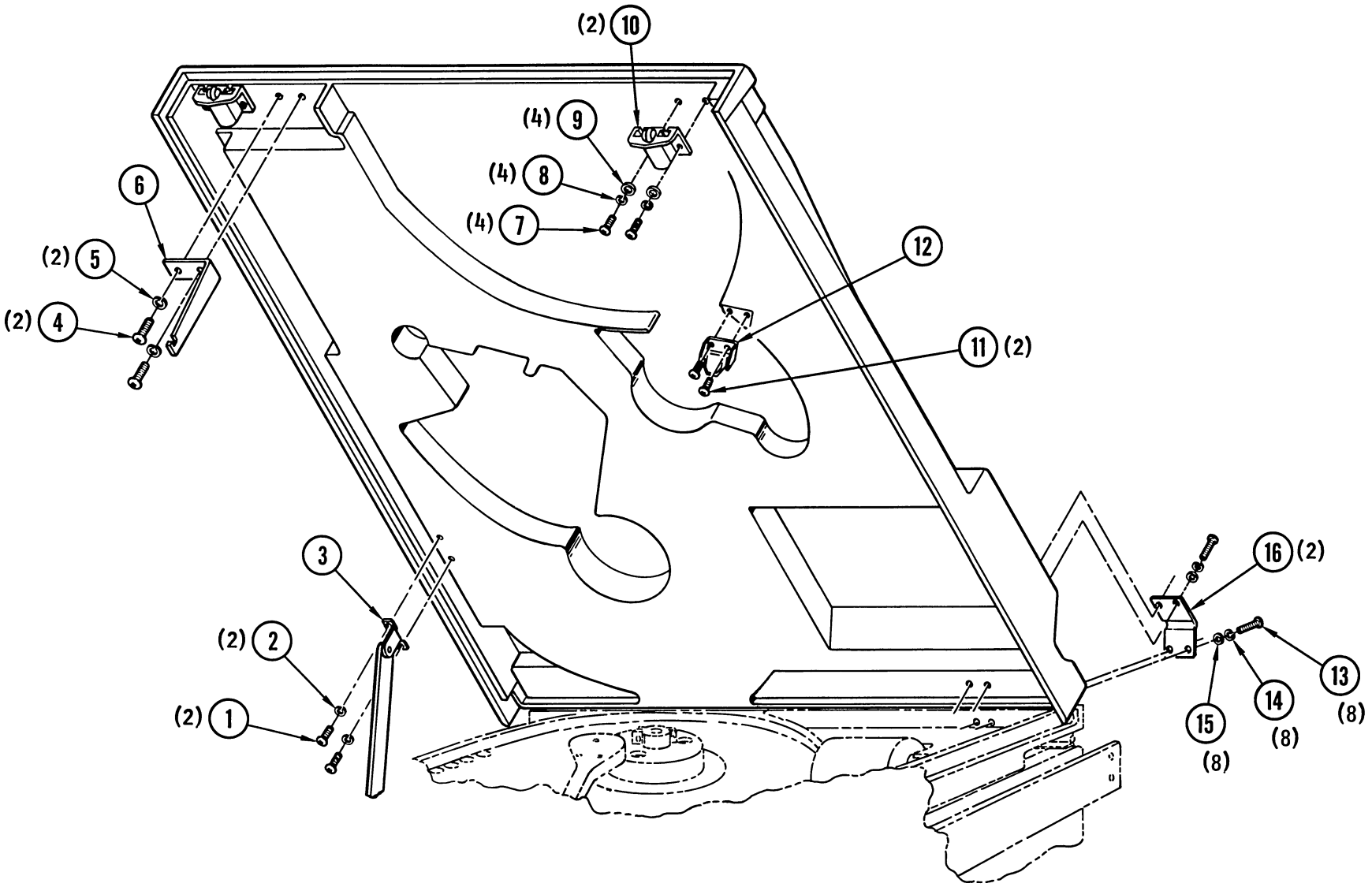

Figure 4-14. Top Cover Assembly

TAKEUP HUB ASSEMBLY (8, Figure 4-5).

4-29. **Removal, Replacement, and Adjustment (Figure 4-15).** Place the transport in operator maintenance access position in accordance with paragraph 4-2, and proceed as follows:

a. Secure tachometer assembly (1) away from the takeup hub.

b. Loosen socket-head screws (2, Figure 4-15) and remove hub (3).

c. Install replacement hub on shaft and position hub height gauge, Cipher part No. 760105-545, as shown in Figure 4-16.

d. Position hub on shaft so that hub height gauge is in contact with both the raised machined area of the top plate and takeup hub, and tighten socket-head screws (2).

e. Remove tool, carefully replace tachometer assembly against hub, restore transport to operating position, and load tape.

f. Run tape forward and reverse using Service Aid 23, noting tape position on replacement hub. If tape is centered on hub, adjustment is correct. If not, loosen socket-head screws (2) and repeat steps b through e.

g. Place transport in operating position.

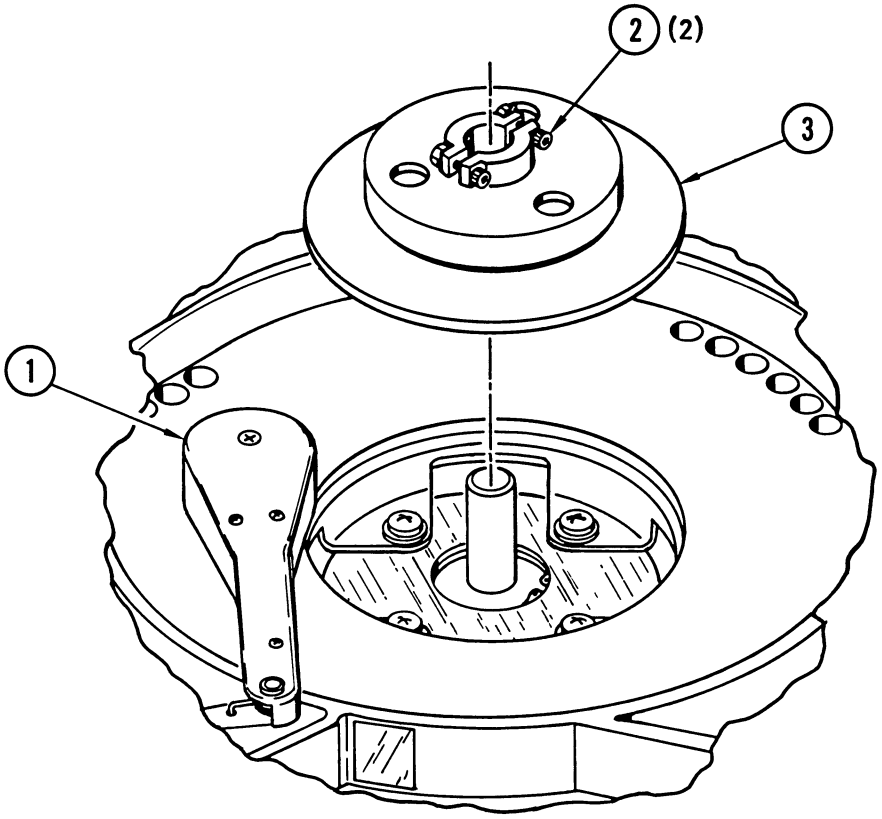

Figure 4-15. Takeup Hub

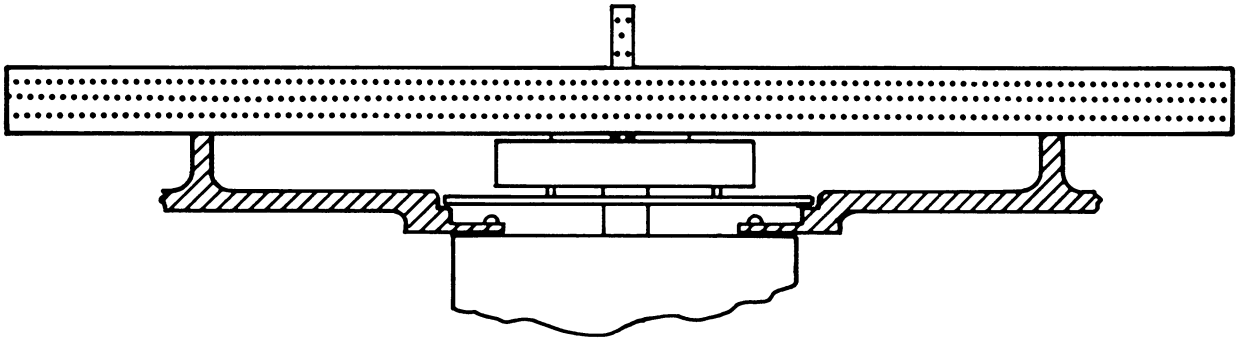

Figure 4-16. Takeup Hub Adjustment

COMPLIANCE ARM ASSEMBLY (9 Figure 4-5), AIR CAPACITOR ASSEMBLY (9, Figure 4-6).

NOTE

To facilitate removal of the compliance arm assembly, this procedure combines the removal, disassembly, assembly and installation of the compliance arm assembly with that of the air capacitor.

4-30. **Removal and Disassembly (Figure 4-17).** Place the transport in service access position in accordance wih instructions in paragraph 4-3. Proceed as follows:

NOTE

Save all attaching parts for use in reassembly.

a. Remove the top plate air duct. Refer to paragraph 4-41. Do not remove Ty-rap.

b. Remove two screws (1), and flat washers (2) attaching air capacitor shutter blade (3) to hub (4), and remove blade (3) from air capacitor stator (7).

c. Remove wire terminals clipped to air capacitor stator (7) plates and identify for reassembly.

d. Remove two allen-head screws (5) and one allen-head screw (6), and remove air capacitor stator (7) from top plate.

e. Loosen socket head screw (8) and remove shutter hub (4) from end of compliance arm shaft.

f. From top side of plate, remove spring (9) from bracket (10).

g. From bottom side of top plate, remove retaining ring (11), wavespring washer (12), and shim (13). Lift compliance arm assembly from top plate. Remove lower bearing (14) or upper bearing (15) only if it requires inspection and/or replacement. These bearings are attached to top plate with Loctite 601.

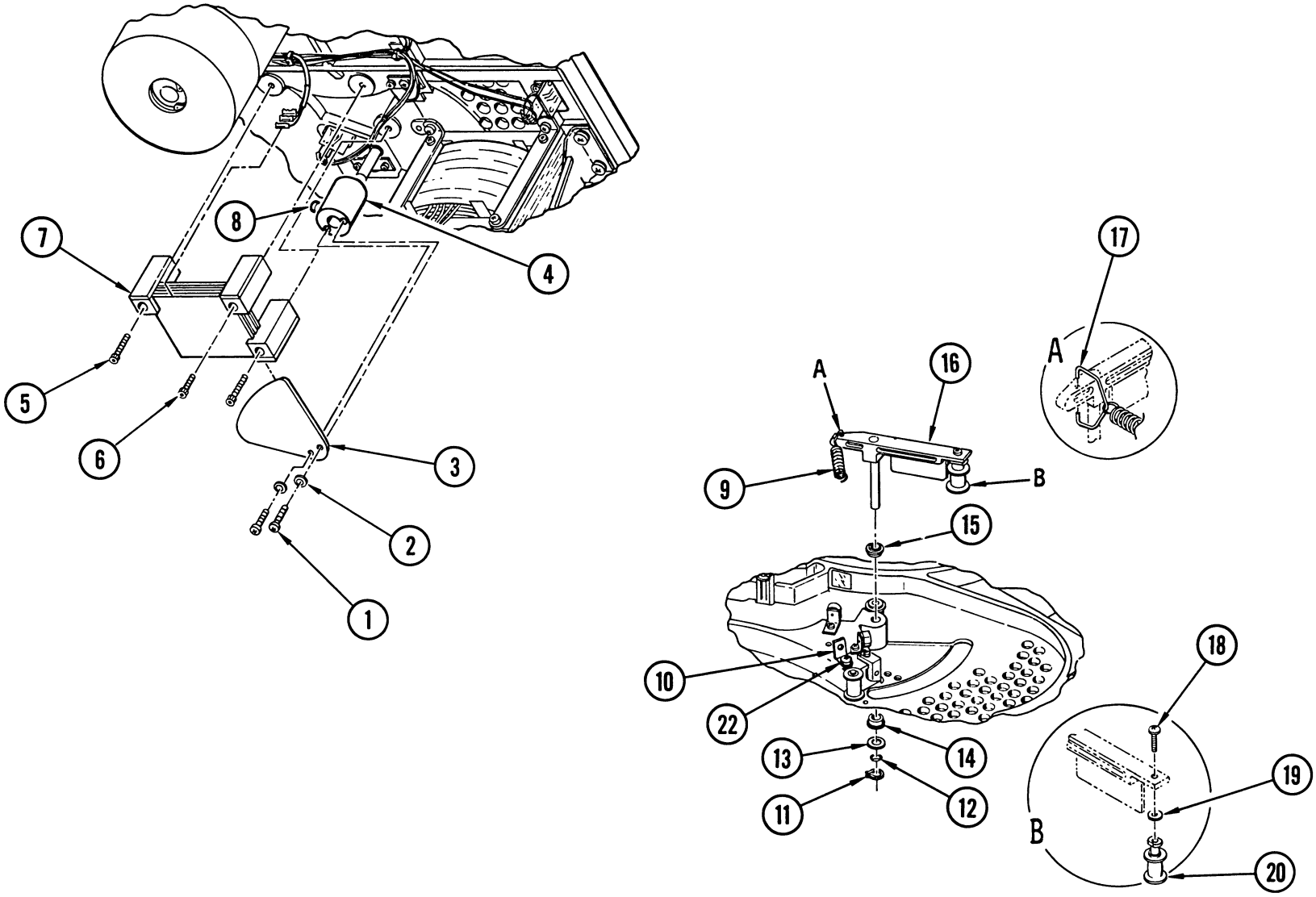

Figure 4-17. Compliance Arm and Air Capacitor Assemblies

h. Remove clip (17) from arm (16) by spreading ends out of hole in arm.

i. To remove tape guide (20), remove screw (18), and shim (19), saving shim for reassembly.

4-31. **Reassembly, Installation, and Adjustment.** Reassemble and install the compliance arm and air capacitor assemblies as follows:

a. Replace defective parts and reassemble compliance arm assembly as shown in Figure 4-17, in reverse order of steps g through i, paragraph 4-30, observing the following special instructions.

(1) Use attaching parts and shims saved from removal and disassembly as necessary.

(2) Apply Lubriplate to bearing surfaces between clip (17) and arm (16).

b. If bearing (14) or (15) was removed, apply small amount of Loctite 601 around outside of bearing and replace.

c. Install shaft carefully through bearings in top plate.

d. Install shim (13), wavespring washer (12), and retaining ring (11) on bottom of shaft. Check wavespring washer (12) to see that it is compressed half of its height. If not, add shims (13) as necessary, checking compliance arm for freedom of movement.

e. Slip hub (4) of capacitor shutter over end of compliance arm shaft, tightening socket head screw (8) just enough to hold hub on shaft.

f. Mount air capacitor stator (7) to under side of top plate with one screw (1/2 - inch) (6), and two screws (5/8-inch) (5), applying Loctite 242 to screws before insertion.

g. Slip blade (3) of capacitor shutter between two upper plates of capacitor stator (7), and attach to hub (loosen hub if required) with two screws (1), and flatwashers (2).

h. Rotate compliance arm assembly to front bumper and secure with Ty-rap.

i. Loosen hub socket head screw (8) slightly, rotate capacitor shutter blade (3) to within 0.1 inch of power supply housing, and adjust height of hub so that rotor blade does not bind on either plate of capacitor stator (7).

j. Tighten hub socket head screw (8).

k. Remove Ty-rap securing compliance arm assembly to front bumper and allow compliance arm to rotate to rear bumper (under its own weight). If compliance arm does not swing freely, readjust height of capacitor shutter, steps i and j, until compliance arm swings freely.

l. Attach compliance arm spring (9) to bracket (10).

m. Clip wire terminals to air capacitor stator (7) plates at points from which removed in step b, paragraph 4-30.

n. Place transport in operator maintenance access position (paragraph 4-2).

CAUTION

To prevent data reliability problems due to improper tape tension the position of the compliance arm spring bracket (10) is factory aligned and should not be changed unless necessary.

o. If spring bracket position was changed, adjust for proper spring tension as follows:

(1) Attach 0 to 36 oz. spring scale, available from John Chatillon & Sons, 83-30 Kew Gardens Rd., Kew Gardens, New York 11415, Part No. LP36, to compliance arm by inserting hook end of scale into notch provided on top of compliance arm near the pivot point.

(2) Loosen screw (22) attaching bracket (10) and position bracket so that screw (22) is in the center of its slotted adjustment range.

(3) Pull spring scale toward front panel of transport until compliance arm roller is positioned between 4th and 5th row (from front panel) of holes in top plate. Scale must be held perpendicular to compliance arm.

(4) With compliance arm positioned between 4th and 5th holes in top plate, spring scale should indicate 19 ±2 ounces. Adjust spring bracket to obtain this reading by moving bracket to stretch or shorten spring. Any deviation from zero reading should be added or subtracted from spring scale reading.

(5) Verify that minimum spring tension required to move arm from rest position is 10 ounces.

(6) If readjustment is required in either substep (4) or (5), reverify both readings.

p. Use Service Aid 24 to test compliance arm and air capacitor assemblies.

TAPE-IN-PATH SENSOR, TRANSMITTER (10, Figure 4-5).

4-32. **Removal and Replacement (Figure 4-18).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Remove connector at back of top plate from tape-in-path sensor transmitter.

b. Remove two screws (1, Figure 4-18) and lockwashers (2) and pull transmitter (3) carefully through hole from back of top plate.

c. Position replacement sensor transmitter carefully in place through hole from back of top plate and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, transmitter.

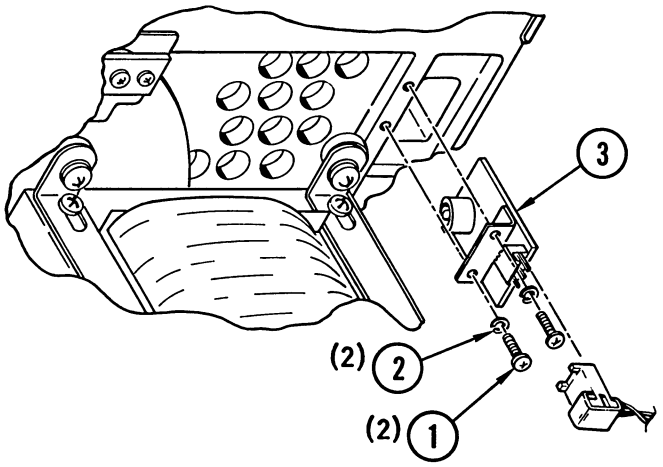

Figure 4-18. Tape-in-Path Sensor, Transmitter

TAPE-IN-PATH SENSOR, RECEIVER (11, Figure 4-5).

4-33. **Removal and Replacement (Figure 4-19).** Place the transport in service access position in accordance with paragraph 4-2 and proceed as follows:

a. Remove connector at back of top plate.

b. Remove attaching screw (1, Figure 4-18), lockwasher (2), and flatwasher (3) and remove tape-in-path sensor receiver (4). Save attaching parts for reassembly.

c. Install replacement receiver using screw (1), lockwashers (2) and flatwasher (3).

d. Reinstall connector.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, receiver.

COMPLIANCE ARM BUMPER ASSEMBLY (12, Figure 4-5).

4-34. **Removal and Replacement (Figure 4-20).** With the transport in operator maintenance position (paragraph 4-2), proceed as follows:

a. Remove screw (1, Figure 4-20), lockwasher (2), and bumper assembly (3).

b. Reinstall in reverse order of removal, and adjust to contact compliance arm squarely. Ensure spring (4) does not touch bumper in the compliance arms full arc of travel. Reposition bumper to clear spring if required.

c. Place transport in operating position.

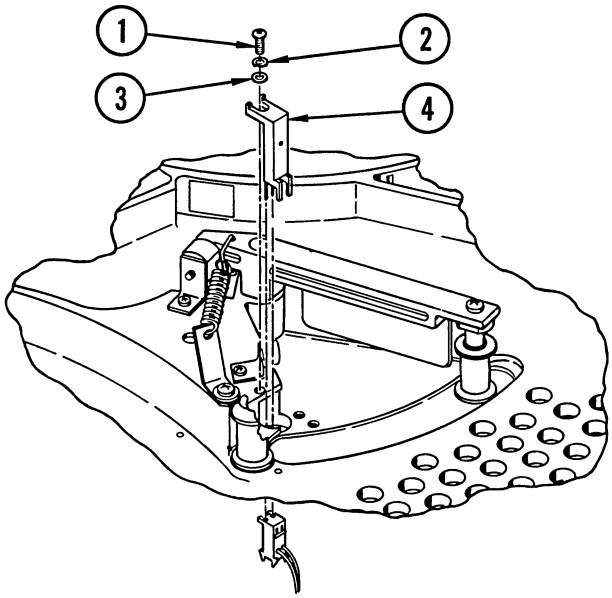

Figure 4-19. Tape-in-Path Sensor, Receiver

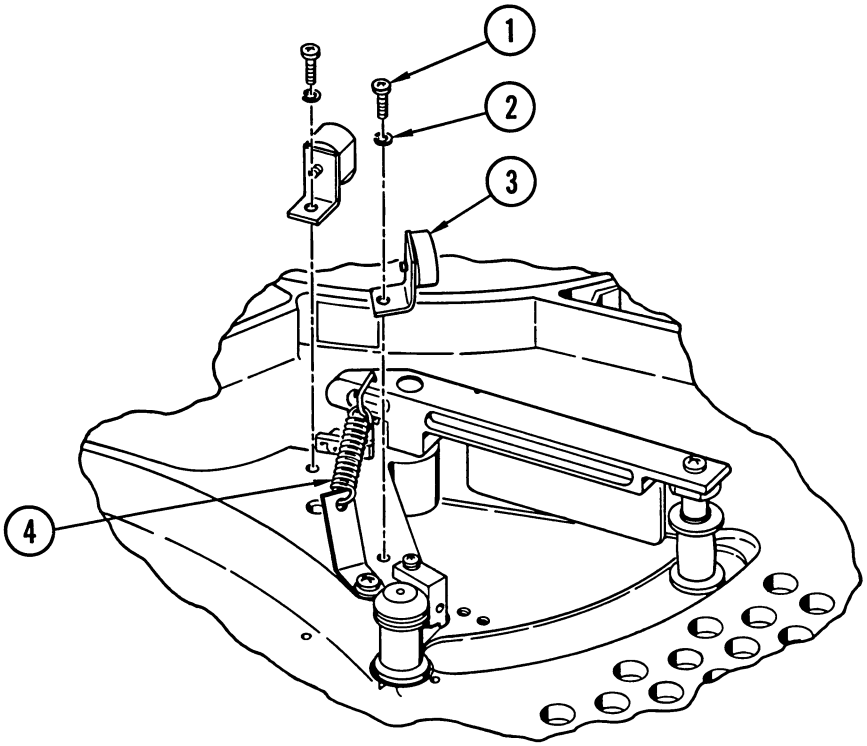

Figure 4-20. Compliance Arm Bumper Assembly

ROLLER TAPE GUIDE ASSEMBLY (SOLID) (13, Figure 4-5).

4-35. **Removal and Replacement (Figure 4-21).** Place the transport in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove attaching screw (1, Figure 4-21) and lockwasher (2), and leaving shims in place remove tape guide assembly (solid) from top of top plate. Save attaching parts for reinstallation.

b. Reinstall tape guide assembly (solid) (3) in reverse order of step a.

c. Perform tape alignment procedure in accordance with instructions in paragraph 4-50.

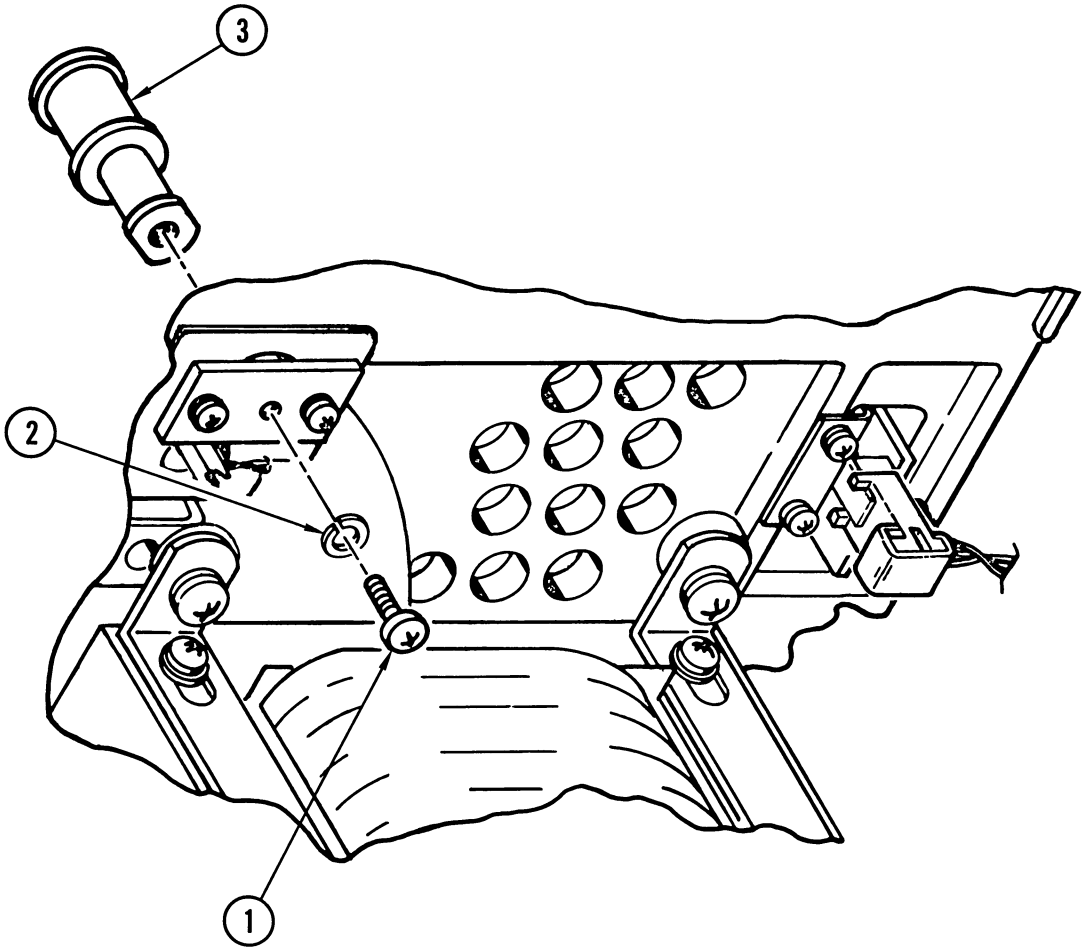

Figure 4-21. Tape Guide Assembly (Solid)

FILE-PROTECT SENSOR (14, Figure 4-5).

4-36. **Removal and Replacement (Figure 4-22).** Place the transport in service access position in accordance with paragraph 4-3 and proceed as follows:

a. Remove connector (back of top plate) from file-protect sensor (3, Figure 4-22).

b. Remove two screws (1) and lockwashers (2) and pull sensor (1) carefully through hole of top plate. Save attaching parts for reassembly.

c. Position replacement sensor carefully through hole and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test file-protect sensor.

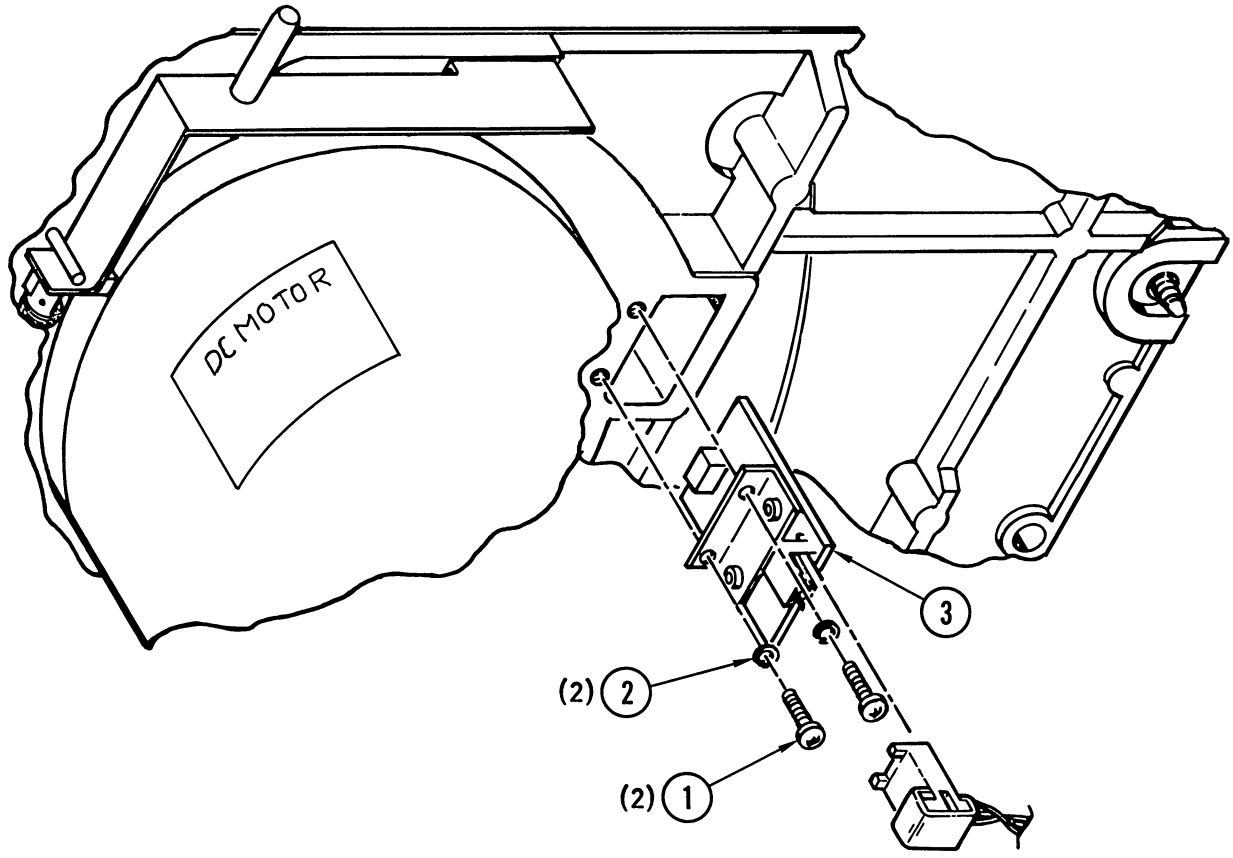

Figure 4-22. File-Protect Sensor

DRIVE MAIN PRINTED WIRING BOARD (PWB) ASSEMBLY (1, Figure 4-6).

4-37. **Removal and Replacement (Figure 4-23).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove power cord from outlet.

b. Remove screw (1), lockwasher (2), and flat washer (3) from front center of board.

c. Remove all connectors.

d. Lift front of board over lip on chassis, slide forward and remove I/O connectors.

e. Remove board from chassis.

f. Position replacement board and install I/O connectors.

g. Reconnect all connectors.

h. Secure board with screw (1), lockwasher (2), and flat washer (3).

i. Place transport in operating position.

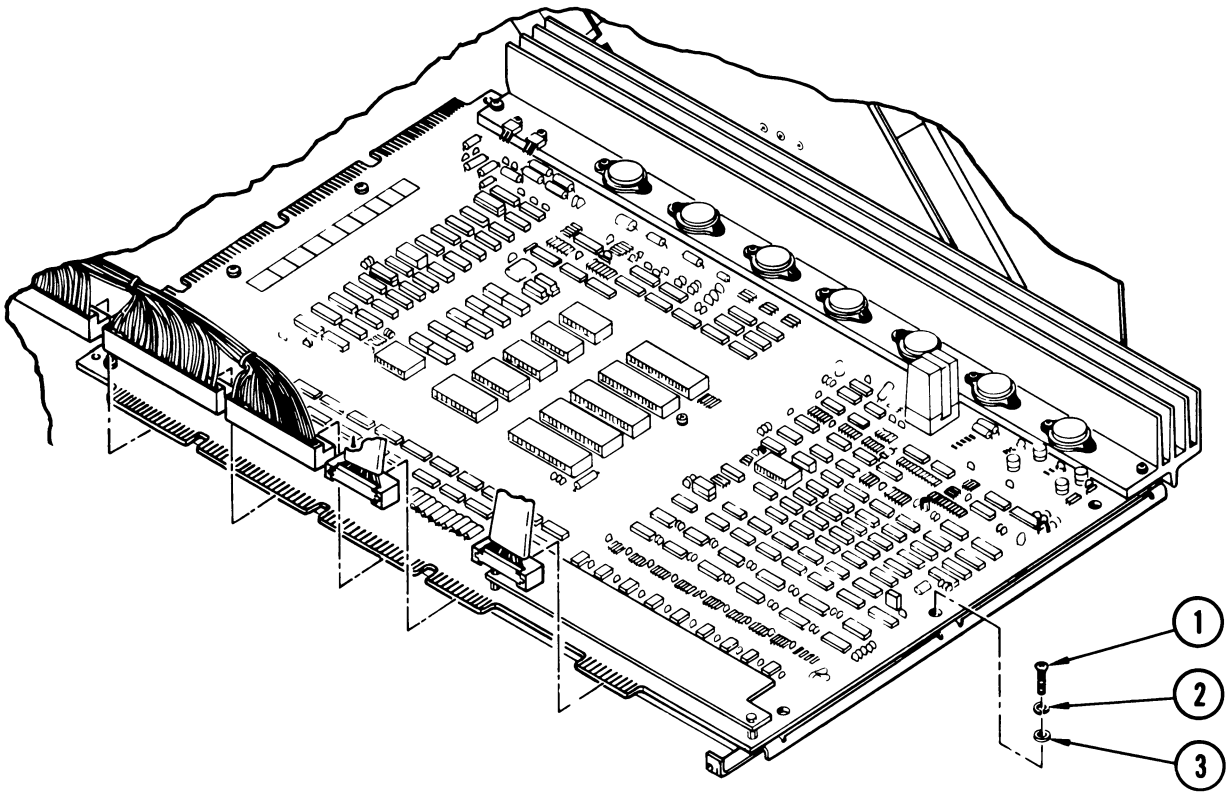

Figure 4-23. Drive Main Printed-Wiring Board

POWER SUPPLY ASSEMBLY (2, Figure 4-6).

4-38. **Removal and Replacement (Figure 4-24).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Turn power off and remove power cord from rear of power supply chassis.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

NOTE

Although not required, the following steps are simplified by removal of the top plate air duct (paragraph 4-41), front panel air duct (paragraph 4-42) and air intake tube (paragraph 4-43).

c. Remove screws (1, Figure 4-24), lockwashers (2), and flatwashers (3) securing power supply cover (4).

d. Remove wiring harness from clip cord (5) securing wiring harness to outside of power supply chassis, and disconnect wiring harness connector from power supply PWB.

e. Remove screws (6), lockwashers (7), and flatwashers (8) securing power supply chassis to top plate.

f. Remove screws (9), lockwashers (10), and flatwashers (11) securing chassis to rear bracket.

g. Disconnect air pump wires (13) and terminals from EMI filter (12) noting position from which removed.

h. If air pump assembly (15) is to be replaced, remove nuts (14) securing air pump to chassis.

i. Install replacement assembly in reverse order of removal ensuring transformer and power switch wire bundles are routed through the housing opening near the top plate.

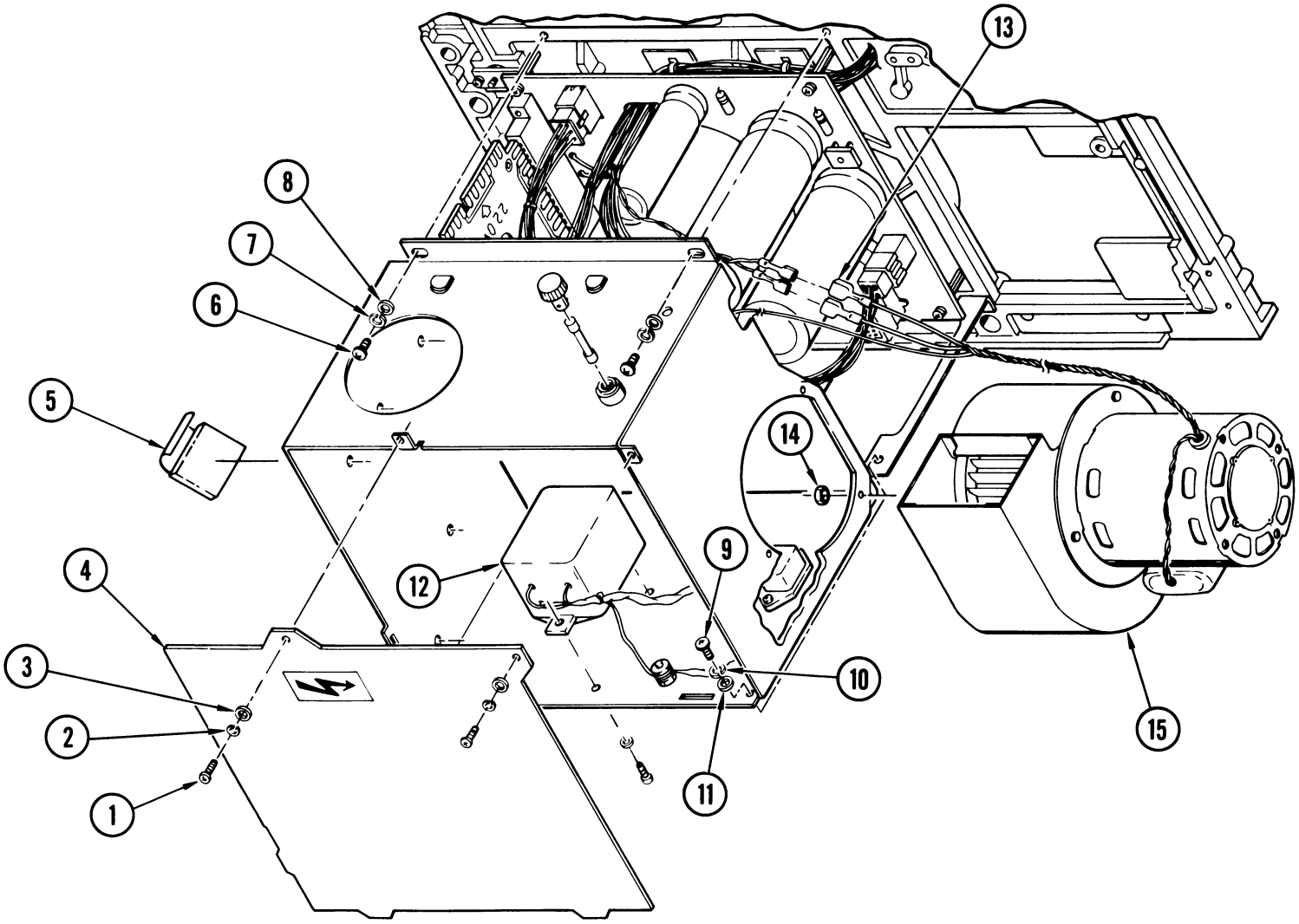

Figure 4-24. Power Supply Assembly

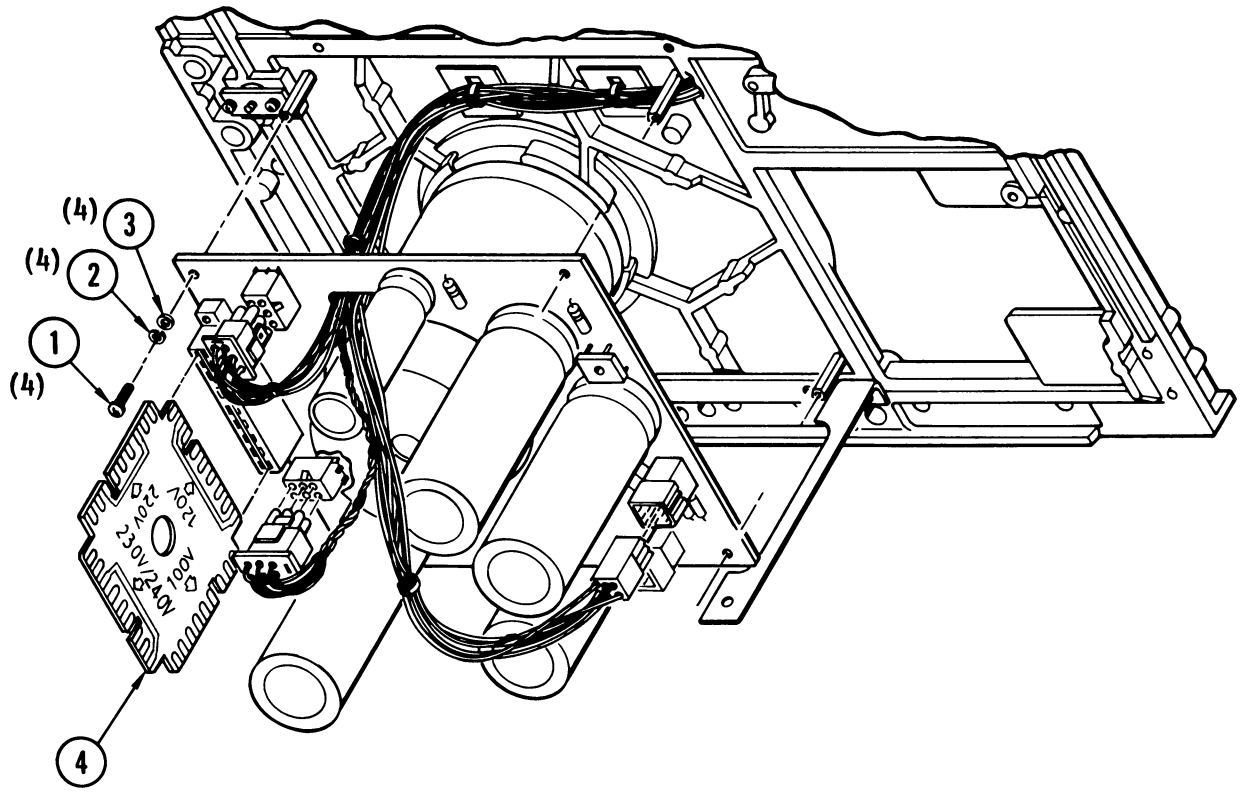

Figure 4-25. Power Supply PWB

POWER SUPPLY PWB (3, Figure 4-6).

4-39. **Removal and Replacement (Figure 4-25).** Place the drive in service access position in accordance with instructions in paragraph 4-3 and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove power supply assembly in accordance with instructions in paragraph 4-38.

d. Disconnect all wiring harness connectors from power supply PWB.

e. Remove screws (1), lockwashers (2), and flatwashers (3), and carefully lower power supply PWB while feeding cables through board opening. Remove voltage selection card (4).

f. Reconnect all connectors to replacement PWB and replace voltage selection card (4).

g. Hold PWB in place and secure with screws (1), lockwashers (2), and flatwasher (3).

h. Replace power supply chassis in reverse order of instructions in paragraph 4-38.

i. Place drive in operating position.

TAKEUP MOTOR ASSEMBLY (4, Figure 4-6).

4-40. **Removal, Replacement and Adjustment (Figure 4-26).** Place the transport in service access position, in accordance with paragraph 4-3, and remove and replace the takeup motor assembly in accordance with the following procedure:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove takeup hub in accordance with paragraph 4-29.

d. Remove power supply assembly cover in accordance with instructions in paragraph 4-38.

e. Disconnect motor wire terminals identifying as necessary for reinstallation.

f. Remove four screws (1, Figure 4-26), lockwashers (2), flatwashers (3), shoulder washers (4), and takeup motor (6) out of drive, noting orientation of motor. Save attaching parts, including insulator (5), for use in assembly.

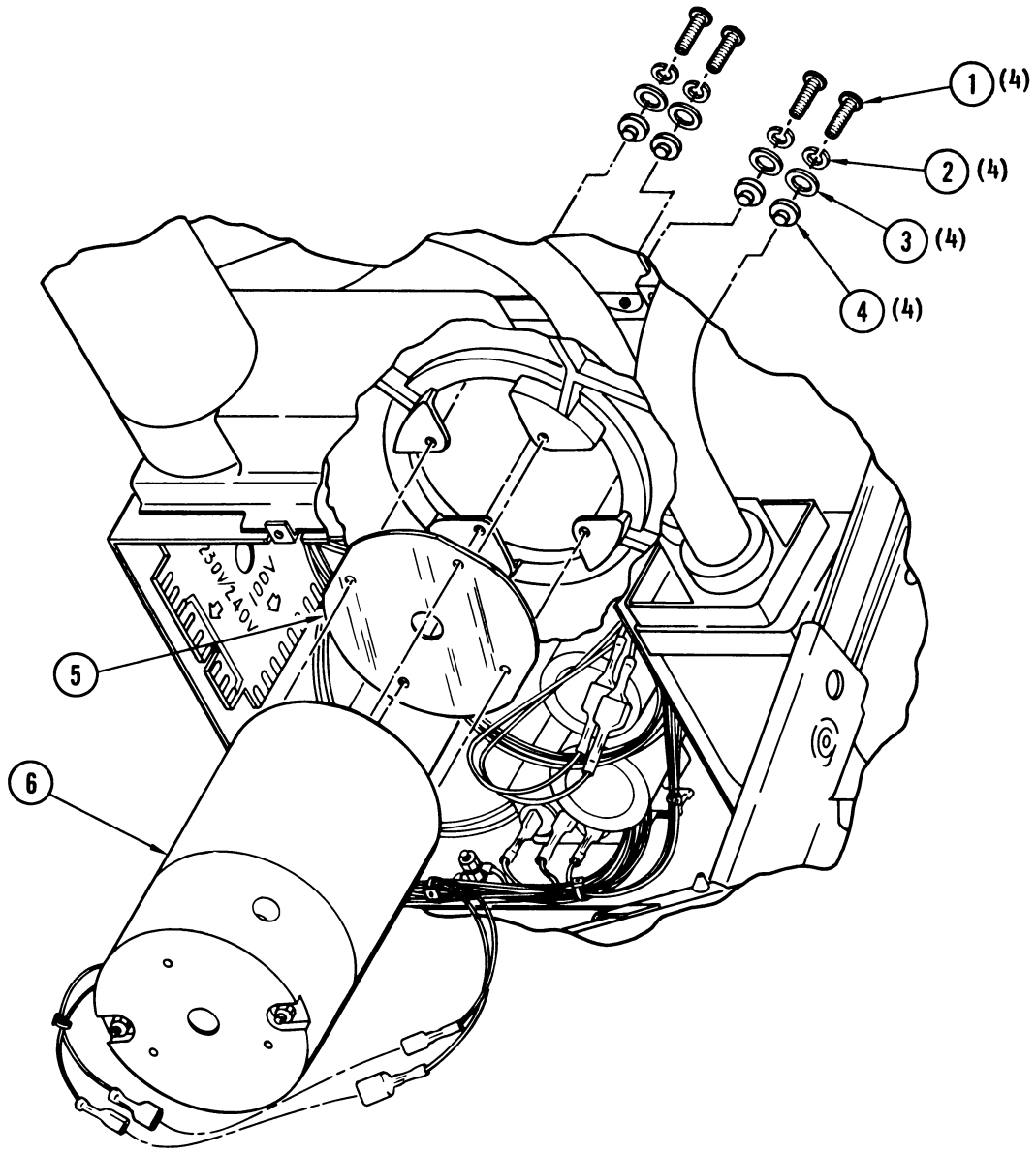

Figure 4-26. Takeup Motor Assembly

g. Install replacement motor in same orientation as motor removed in step f, in reverse order of steps e and f.

h. Reinstall power supply cover in accordance with instructions in paragraph 4-38.

i. Reinstall and adjust takeup hub in accordance with paragraph 4-29.

j. Reinstall main PWB in accordance with instructions in paragraph 4-37.

k. Use Service Aid 11 to test motor operation.

AIR DUCT, TOP PLATE (5, Figure 4-5), AIR DUCT, FRONT PANEL (6), TUBE, AIR INTAKE (7).

4-41. **Removal and Replacment (Figure 4-27).** Place the transport in service access position (paragraph 4-3). To replace the top-plate air duct, proceed as follows:

a. Remove head connectors J6/J7 from main PWB and cable retractor (5). At top-plate end of top-plate air duct (4), remove screw (1), lockwasher (2), and flatwasher (3).

b. Pull other end from blower adapter (6), and remove air duct.

c. Remove cable retractor (5) from old duct and secure with Ty-rap on replacement duct.

d. Install replacement duct by slipping flared end over blower adapter (6) and reinstalling screw, lockwasher and flat washer.

e. Place transport into operating position.

4-42. **Front Panel Air Duct (Figure 4-27).** Replace the front panel air duct as follows:

a. Note positions of power switch harness and safety pin retractor Ty-raps on duct and remove.

b. Remove front panel in accordance with instructions in paragraph 4-21, steps a, b, and c, but do not remove switch wire terminals and connectors.

c. Pull front panel just far enough away from transport to remove gooseneck end of front-panel air duct (7), noting position from which removed with reference to air deflector on front, right-hand edge of top plate.

d. Pull other end of duct off blower adapter (6).

e. To install replacement front-panel air duct (7), place flared end of duct on blower adapter.

f. Position gooseneck end of duct so that it opens into air deflector and holding end of duct in place, replace front-panel assembly, squeezing positioning block of front-panel over gooseneck, ensuring that air intake tube (8) is in place in front-panel adapter (9) and power supply.

g. Reinstall front panel assembly in accordance with paragraph 4-21, step f.

h. Fasten power switch wiring harness and safety pin retractor to duct with Ty-raps per step a notation.

i. Place transport in operating position.

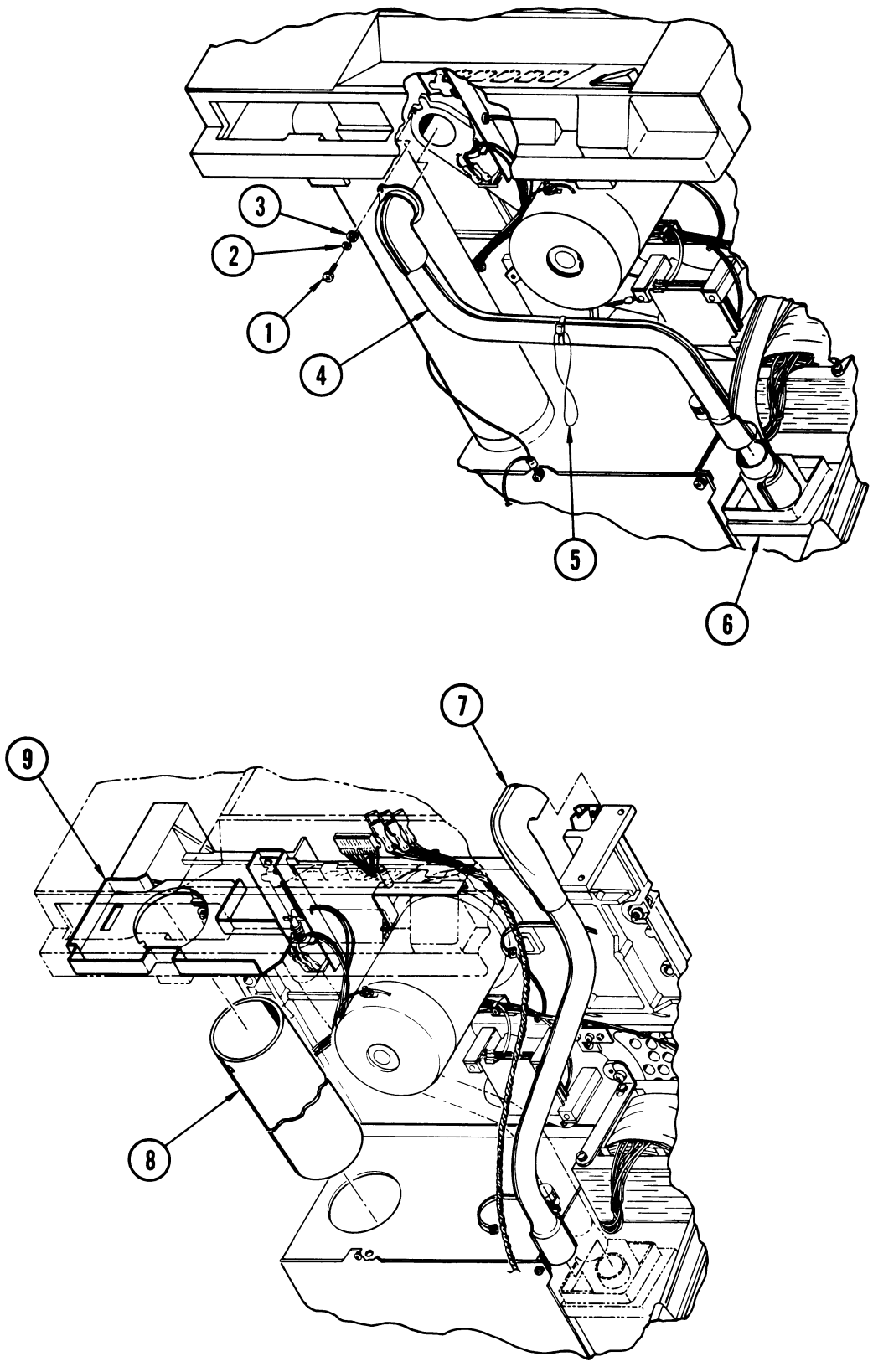

Figure 4-27. Top Plate Air Duct,
Front Panel Air Duct, Air Intake Tube

4-43. **Air Intake Tube. (Figure 4-27).** Replace the air intake tube as follows:

a. Remove the filter. Refer to paragraph 4-13.

b. Place unit in service access position.

c. Remove air intake tube (8) from power supply case by depressing tube slightly at hole (bottom of tube) to disengage tooth and slide forward into front panel adapter (9).

d. Remove front panel as in paragraph 4-42, but do not remove Ty-raps, etc.

e. Slide air intake tube out of front panel adapter.

f. Install replacement tube in reverse order of removal.

g. Place transport in operating position.

SUPPLY MOTOR ASSEMBLY (8, Figure 4-6).

4-44. **Removal and Replacement (Figure 4-28).** Place transport in service access position, in accordance with instructions in paragraph 4-3, and remove and replace the supply motor assembly as follows:

a. Remove power cord from outlet.

b. Remove supply hub in accordance with paragraph 4-23.

c. Disconnect motor wire terminals from wire leads, identifying each as necessary for reinstallation.

d. Remove bell crank retaining ring (5, Figure 4-28).

e. Remove screw (1) lockwasher (2), flatwasher (3), shoulderwasher (4), and insulator (6), holding motor (7) as last screw is being removed.

f. Lower motor (7) from top plate, simultaneously slipping bellcrank off post on top of motor.

g. Install replacement motor with bellcrank post nearest bellcrank, slipping bellcrank onto post, in reverse order of removal.

h. Install retaining ring on bellcrank post (paragraph 4-45).

i. Connect motor wire terminals as identified in step c.

j. Reinstall and adjust supply hub in accordance with instructions in paragraph 4-23.

k. Use Service Aid 11 to test motor operation.

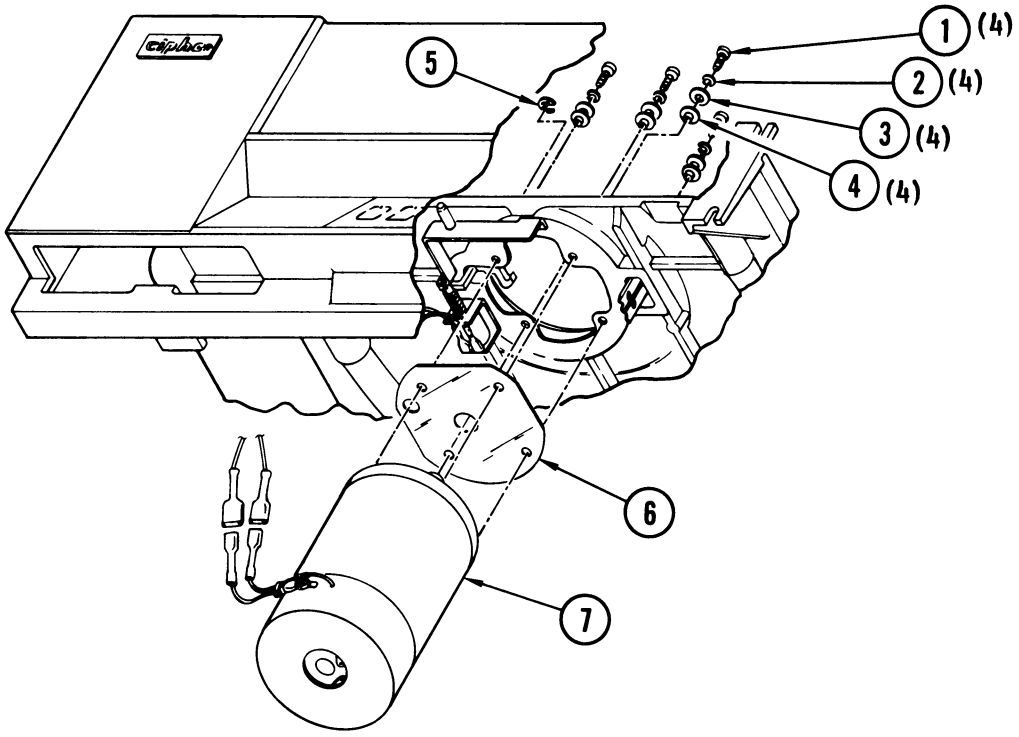

Figure 4-28. Supply Motor Assembly

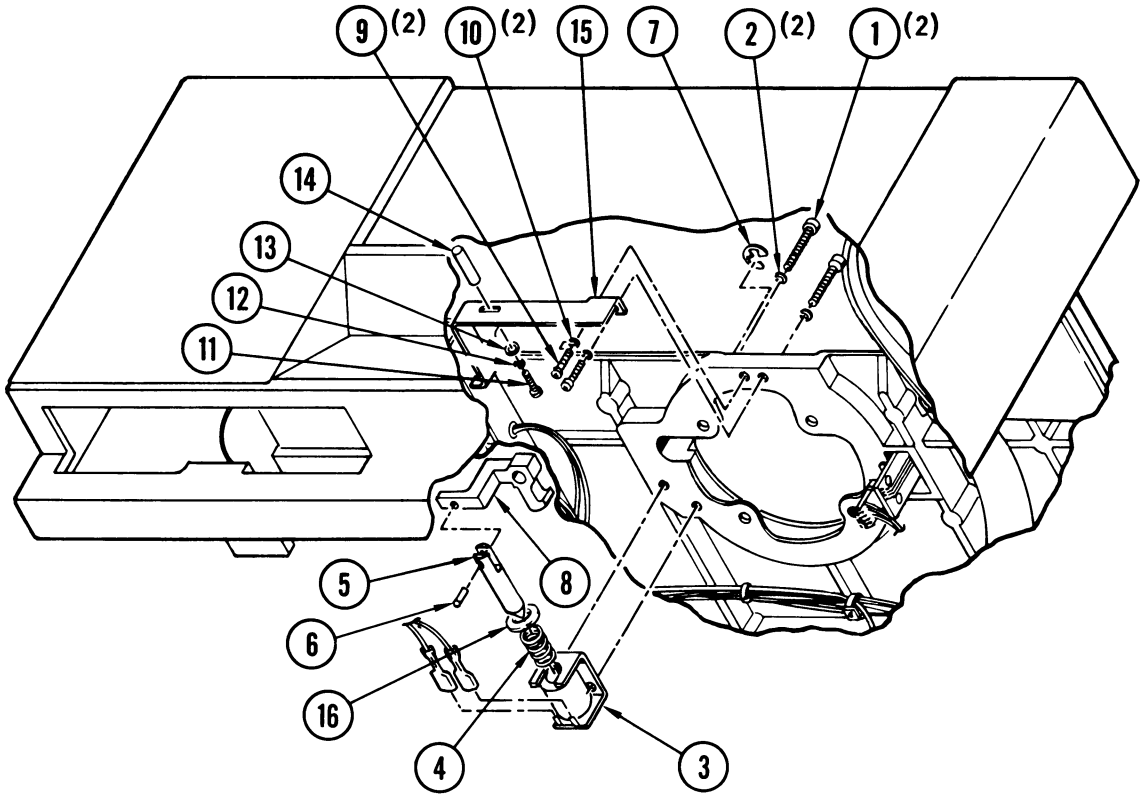

Figure 4-29. Hub Lock Assembly

HUB LOCK ASSEMBLY (10, Figure 4-6).

4-45. **Disassembly, Removal and Replacement (Figure 4-27).** To disassemble hub lock assembly and remove parts from top plate and supply motor, proceed as follows:

a. Remove power cord from outlet.

b. Place transport in service access position in accordance with instructions in paragraph 4-3.

c. Remove wire terminals from solenoid (3, Figure 4-27) and identify for reassembly.

d. Remove two screws (1), and lockwashers (2), and remove solenoid (3) from top plate and spring (4) and washer (16) from solenoid plunger (5).

e. If plunger (5) or bellcrank (8) must be replaced, remove supply motor in accordance with instructions in paragraph 4-44. Remove retaining ring (7) and bellcrank (8) from motor, and press out pin (6), releasing plunger (5).

4-46. **Reassembly and Installation.** Replace defective parts, and reassemble and install the hub lock assembly as follows:

a. Install bellcrank (8) on supply motor with retaining ring (7). Reinstall motor on top plate in accordance with instructions in paragraph 4-44.

b. Complete reassembly and reinstall solenoid (3) on top plate in reverse sequence of steps c and d, paragraph 4-45.

c. Place transport in operating position.

d. Use Service Aid 32 to test hub lock assembly operation.

4-47. **Manual Unlock Assembly (Hub Lock) (Figure 4-27).** To replace the manual unlock assembly or one of its parts, proceed as follows:

a. Place transport in service access position (Paragraph 4-3).

b. Remove manual unlock assembly from top plate by removing two screws (9, Figure 4-27) and lockwashers (10).

c. Remove pin (14) from bracket (15) by removing screw (11), lockwasher (12), and flatwasher (13).

d. Reassemble and reinstall in reverse order of steps b and c.

e. Ensure that the hub lock solenoid spring will return the manual unlock assembly fully against the stop pin. Reposition the manual unlock assembly if required.

f. Place transport in operating position.

DOOR LOCK ASSEMBLY (11, Figure 4-6).

4-48. **Removal and Disassembly (Figure 4-30).** Place the transport in service access position in accordance with instructions in paragraph 4-3. Remove the door lock assembly from the top plate and disassemble as necessary to replace defective parts as follows:

a. Remove power cord from outlet.

b. Remove wire terminals from solenoid noting positions for reassembly.

c. Remove door lock assembly from top plate by removing two screws (1, Figure 4-30) and lockwashers (2).

d. Remove slip-on connectors from microswitch noting positions for reassembly and feed through grommet.

e. Remove two screws (3), and lockwashers (4), and remove solenoid (5) from assembly. Remove spring (6) and spacer (7).

f. Remove switch (13), by removing two nuts (8), lockwashers (9), flat washers (10), screws (11) and flat washers (12). Switch may then be removed by sliding out solenoid end of bracket.

g. No further disassembly is recommended.

h. Replace defective parts, and reassemble door lock assembly in reverse sequence of disassembly, steps c and d.

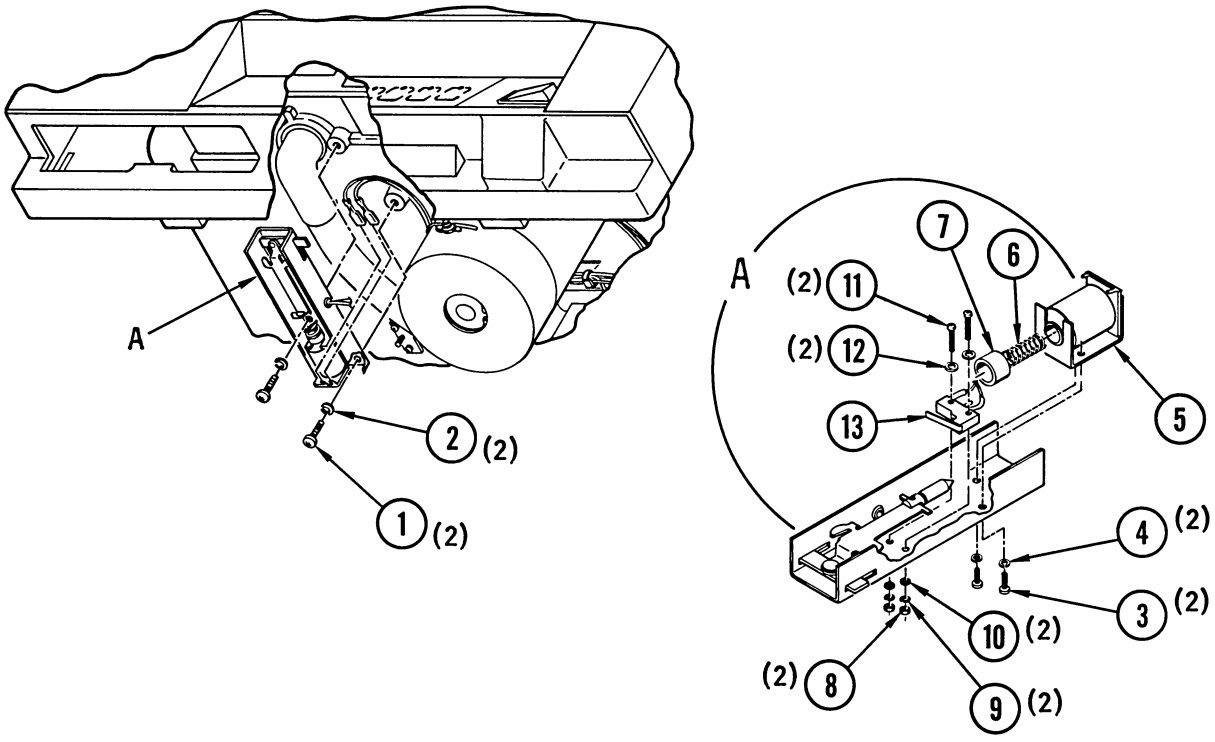

Figure 4-30. Door Lock Assembly

i. Install door lock assembly on top plate with attaching parts removed in step b. Do not tighten screws.

j. Adjust position of door lock assembly as follows:

(1) Close top cover of transport. Position door lock assembly so that the plate is approximately 1/8 inch in front of latching arm of cover lock tab (6, Figure 4-14), and tighten screws.

(2) Applying very light pressure, attempt to close transport door. If door will not close completely, loosen screws (1), push door lock assembly forward until door will close, and retighten screws (1).

(3) Place drive in operating position and connect to power source.

(4) Actuate POWER switch and LOAD touch switch. If only LOAD and POWER indicators illuminate, door lock assembly is properly positioned and adjustment is complete.

(5) If all indicators except ON-LINE are flashing upon execution of step (4), place drive in service access position, loosen screws (1), and pull door lock assembly slightly toward rear of unit.

(6) Repeat steps (3), (4), and (5) until both top cover and door open with POWER switch off and only LOAD and POWER indicators illuminate when these switches are actuated.

k. Place transport in operating position.

TRANSFORMER ASSEMBLY (12, Figure 4-6).

4-49. **Removal and Replacement (Figure 4-31).** To replace the transformer assembly, place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB from transport (paragraph 4-37).

c. Remove power supply assembly and power supply PWB in accordance with paragraphs 4-38 and 4-39.

d. Unplug primary and secondary transfomer connectors from power supply PWB, and cut all Ty-raps securing transformer wire bundles to power supply components and other parts of drive, noting position of Ty-raps before removing.

e. Support transformer (4, Figure 4-31) and remove four screws four (1), four lockwashers (2), and four flatwashers (3), and remove from drive.

f. Install replacement transformer in reverse sequence of step e.

g. Replace Ty-raps removed in step c.

h. Reinstall power supply PWB in accordance with paragraph 4-39, ensuring that transformer wire bundles are properly secured with Ty-raps.

i. Plug in transformer primary and secondary connectors to power supply.

j. Reinstall power supply assembly in accordance with paragraph 4-38, and reinstall drive main PWB in accordance with paragraph 4-37.

k. Place drive in operating position.

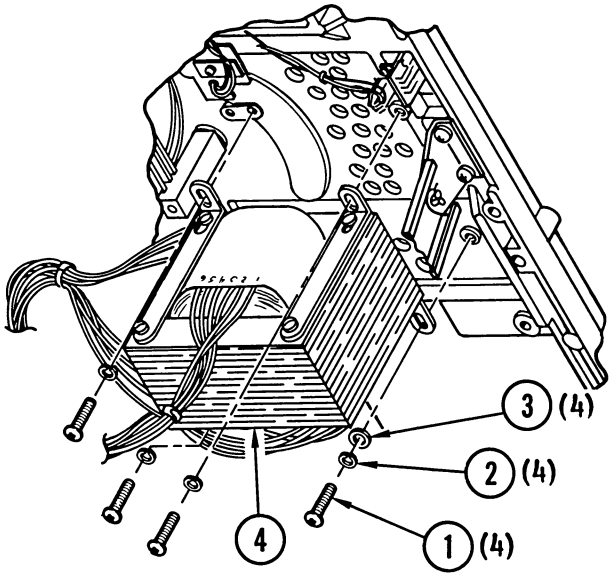

Figure 4-31. Transformer Assembly

TAPE ALIGNMENT

4-50. All tape guides must be checked for proper tape path alignment following replacement of any part in the tape path. Proceed as follows:

a. Actuate power switch to ON.

b. Insert and load a new tape.

NOTE

A used tape may have damaged or weak edges which would adversely affect its tape-path tracking characteristics.

c. Use Service Aid 33 to disable door and top cover lock. Place drive in operator maintenance access position.

d. Ensure that supply reel is properly seated on supply hub.

e. Referring to paragraph 3-32, operate drive in Service Aid 23.

f. If tape is not centered between sides of reel, unload tape and adjust hub height as necessary.

g. Observe position of tape on roller guide (2, Figure 4-32).

h. If tape is not centered on guide, turn power switch to OFF, and remove guide (2) from compliance arm in accordance with paragraph 4-30 step i and Figure 4-17.

i. Add or reduce thickness of shims (20) as required to compensate for off-center position of tape and reinstall guide on compliance arm. Repeat as necessary to obtain correct centering of tape on guide (2).

j. Run tape forward and check for edge curl on guide (3). If curl is present on lower washer, turn power switch to OFF and increase shims under roller guide (1). If curl is present on upper washer of guides (3), decrease shim thickness under roller guide (1). Resume forward tape motion and recheck tape position. Repeat this step until tape tracks smoothly around guide (3).

k. Depress lower washer on guide (3) and check for optimum movement of tape away from top washer of 0.005 inch. If necessary, reshim guide (2) to maintain proper tape centering.

l. Run tape in forward direction and check for edge curl on guide (4). If curl is present, turn transport power to OFF and add or remove shims on guide (5). Do not alter guide (5) more than ±0.005 inch from factory setting.

NOTE

Curl on guide (4) can be caused by improper alignment on any other guide in the tape path. If tracking has been verified on guide (3), tape curl on guide (4) is probably caused by misalignment of guide (5). Normally, improper alignment of guides (1) and (2) will show up as tracking problems on guide (3).

m. Run tape in reverse direction (Service Aid 23) and check for tape curl on all edges.

n. Depress lower washer on guides (3), (4), and (5) and check for optimum tape movement, away from top washer, of 0.005 inch.

o. Add or delete shims on guides (1), (2) and (5) as required to eliminate edge curl on all rollers and reverify forward tape path alignment by checking for maximum tape shift on guide (2) of ±0.015 inch.

p. Check head azimuth and read skew. Refer to paragraph 4-51.

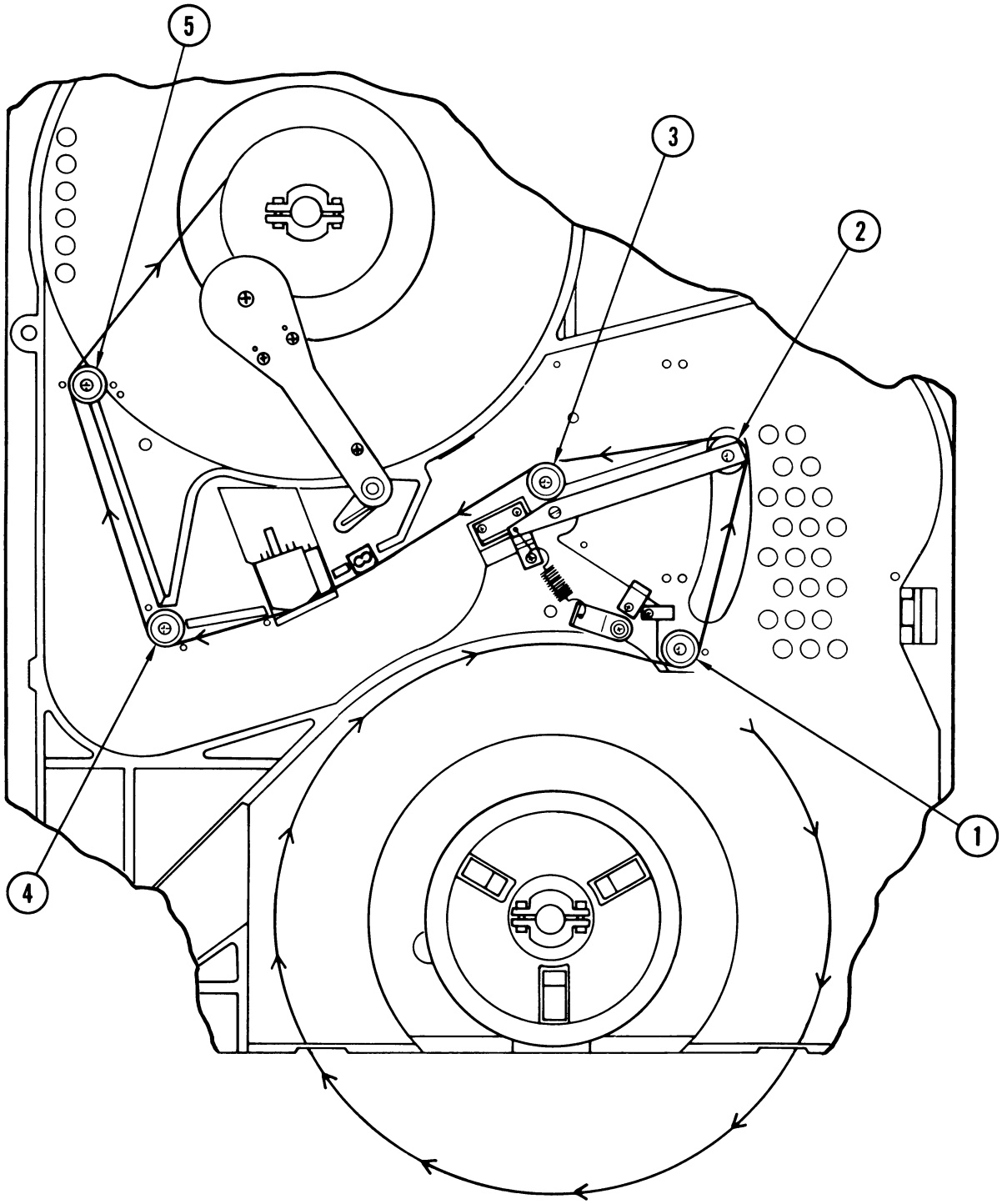

Figure 4-32. Tape Path Adjustment

4-51. **Head Azimuth Adjustment.** Adjust head azimuth as follows:

a. Place drive in service access position.

b. Turn transport power off and attach skew monitor, Cipher Part No. 960067-001 to U14B, U14D, and U14G.

(1) A skew monitor may be constructed using three 14-pin IC clips and nine 47k ohm resistors.

(2) Attach one end of a resistor to pins 9, 11, and 13 on each IC clip.

(3) Connect the other end of all nine resistors together to form a summing junction.

c. Actuate transport power switch to ON and load master skew tape, Cipher Part No. 799019-401.

d. Connect oscilloscope to test point on skew monitor and ground test point.

e. Loosen center adjustment screw (1, Figure 4-10).

f. Referring to paragraph 3-32, operate drive in Service Aid 23.

g. Adjust azimuth screw (1, Figure 4-10) so that outputs of all tracks, as monitored at test point on skew monitor, fall within 24% or less of the byte-to-byte period. (See Figure 4-33)

h. Run tape in reverse direction, using Service Aid 23, and verify reverse skew is within 24% or less of the byte-to-byte period.

i. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing width of skew pulse. The tape should be run from end to end and not rewound to prevent stretching.

j. Appply torque seal, Cipher Part No. 209994-025 to head of adjustment screw.

k. Remove skew tape from transport and load a Pericomp tracking tape, available from Pericomp Corporation, Natick, Massachusetts 01760.

l. Connect oscilloscope to TP 10 and ground.

m. Run tape in forward direction (Service Aid 23) and compare P1 to P2 on oscilloscope trace. See Figure 4-34.

n. Calculate difference in amplitude (positive peak) between P1 and P2 and refer to Table 4-3 for conversion of volts to inches. If P1 is greater than P2, subtract calculated figure from 0.007 inch. If P2 is greater than P1, add figure to 0.007 inch. Reference edge must be 0.007 $\pm$ 0.003 inch.

o. Remove skew monitor and place drive in normal operating position.

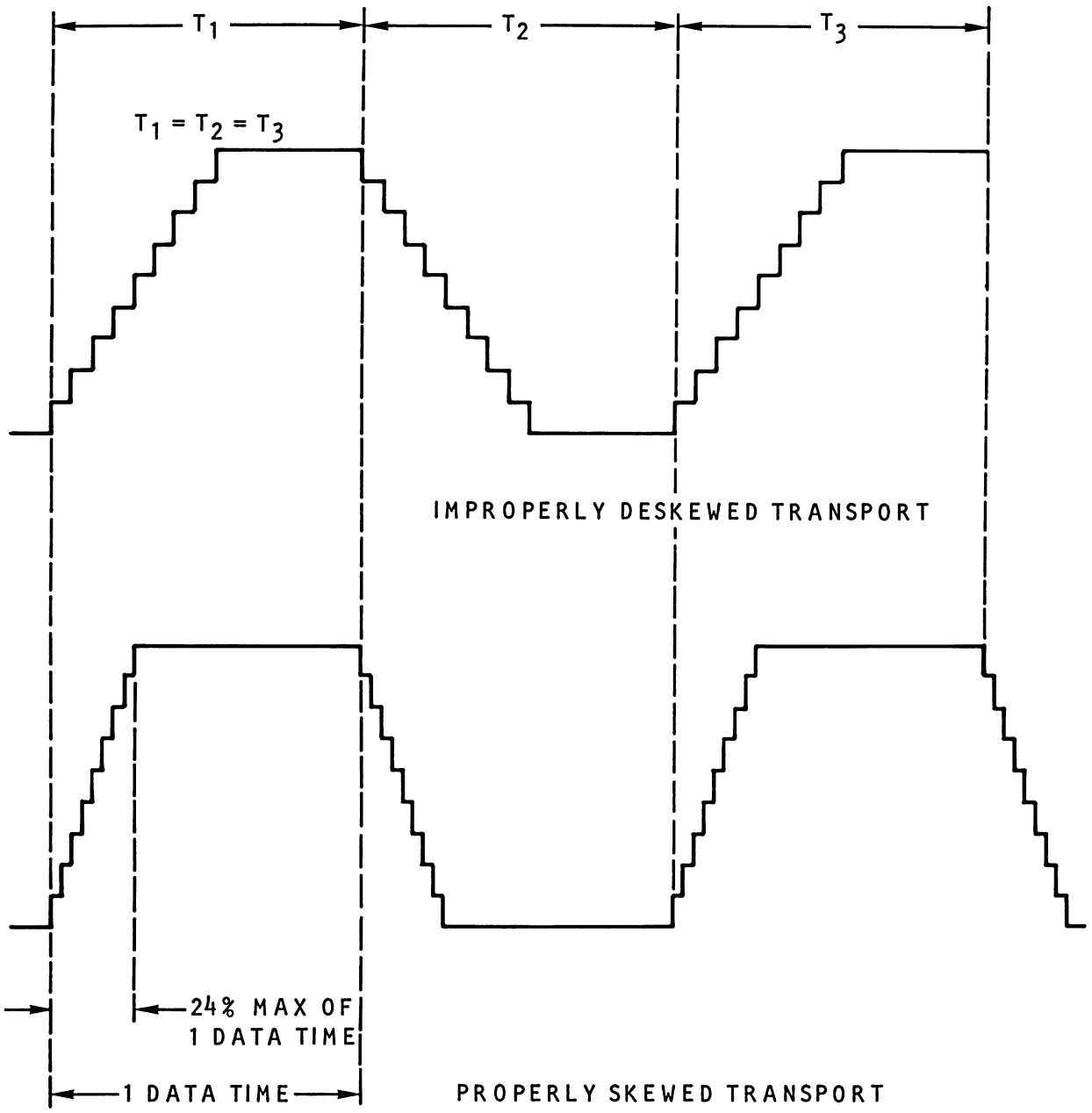

Figure 4-33. Skew Adjustment Waveform

VOLTS	INCHES
0.000 TO 0.024	0.000
0.025 TO 0.049	0.001
0.050 TO 0.074	0.002
0.075 TO 0.100	0.003

Table 4-3. Reference Edge Distance

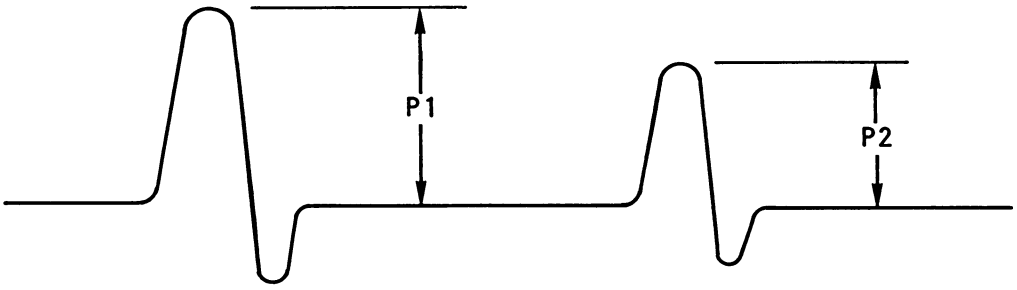

Figure 4-34. Reference Edge Measurement Waveform (TP10)
Using Pericomp Tracking Tape

SECTION V

ILLUSTRATED PARTS BREAKDOWN

INTRODUCTION

5-1. The illustrated parts breakdown divides the Model F880 Magnetic Tape Streamer Unit into assemblies, subassemblies, and component parts. Component parts are properly indented to show their relationship to the next higher assembly. Attaching parts are listed immediately following the item they attach, and preceding the components of that item.

5-2. Exploded view illustrations serve as a visual aid for identification of component parts of each assembly. Index numbers are used to identify the exploded parts shown. In the case of electronic components (capacitors, resistors, diodes, etc.) on a printed wiring board, a reference designation number is assigned to each, consisting of a capital letter (C for capacitor, R for resistor, etc.) and a sequential number, beginning with the numeral 1 for each capital letter. (Printed wiring boards are not exploded.) When used in conjunction with the schematic diagram and the DESCRIPTION column of the parts list, the reference designation numbers provide data required to troubleshoot, repair, or replace any components.

5-3. Figure 5-1 is an overall view of the magnetic tape transport for use in identifying major assemblies. Figures 5-2 through 5-12 represent both an exploded view of these major assemblies and their relationships to the overall assembly.

5-4. Abbreviations used in this section are defined below.

ABBREVIATION	DEFINITION
A or amp	ampere
al	aluminum
cap	capacitor
dia	diameter
ft	feet (or foot)
hex	hexagon
Hz	Hertz

ABBREVIATION	DEFINITION
ID	inner diameter
in.	inch (or inches)
kV	kilovolt
lg	long
meg	megohm
No. or Nos.	number or numbers
NPN	negative-positive-negative (transistors)
OD	outer diameter
	ohm
PNP	positive-negative-positive (transistors)
pF	picofarad
R	resistor
subs	subsequent
thk	thick
uF	microfarad
v	volt (or voltage)
VDC	volts direct current
VAC	volts alternating current
W	Watt
w/	with
x	by (or names)

EXPLANATION OF THE PARTS LIST

5-5. **FIG. & INDEX NO. Column.** Illustrations are numbered sequentially. The item numbers on each illustration are keyed to the same number appearing in the parts list. If a part number is shown for an item, but no index number is shown, the assembly is immediately broken out below the part number and each item in the assembly is given its own index number. If parts are interchangeable, only one index number will be assigned to the item.

5-6. **PART NUMBER Column.** The number that appears in this column will be the Cipher Data part number. In the case of an electronic component (capacitor, resistor, transistor, etc.), its location in an illustration is determined by the grid system, e.g., transistor U11F will be found by reading down the sides of the illustration to row number 11, then across the top of the illustration from right to left until the letter F row is reached. Each electronic component assigned a circuit symbol (i.e., reference designation) will have that designation listed in the Figure & Index No. in alphanumeric sequence. Where the sequence is broken due to the removal, revision, or change of a component, the notation "NOT USED" will appear in the DESCRIPTION column opposite the designation that has been removed.

5-7. **DESCRIPTION Column.** Descriptive data as to type, size, color, etc. is provided to fully identify the part when ordering or replacing. Blueprint titles are normally given first, with the basic noun name in capital letters, followed by additional descriptive terms. Acceptable abbreviations are contained in the abbreviation table above.

5-8. **QTY Column.** This column indicates the quantity of each part required for the assembly or subassembly. This quantity is not necessarily the total quantity used for the complete assembly.

NOTE

The same parts may be used in various subassemblies; or in the case of multiple components with attaching hardware, only the quantity of hardware used to attach one item is given.

5-9. **USABLE ON CODE Column.** This column lists the code letter assigned to the current models of the F880 for identification purposes.

CODE	MODEL
A	Model F880 (125V) (25/100 ips)
B	Model F880 (125V) (25/50/100 ips)
C	Model F880 (VDE)

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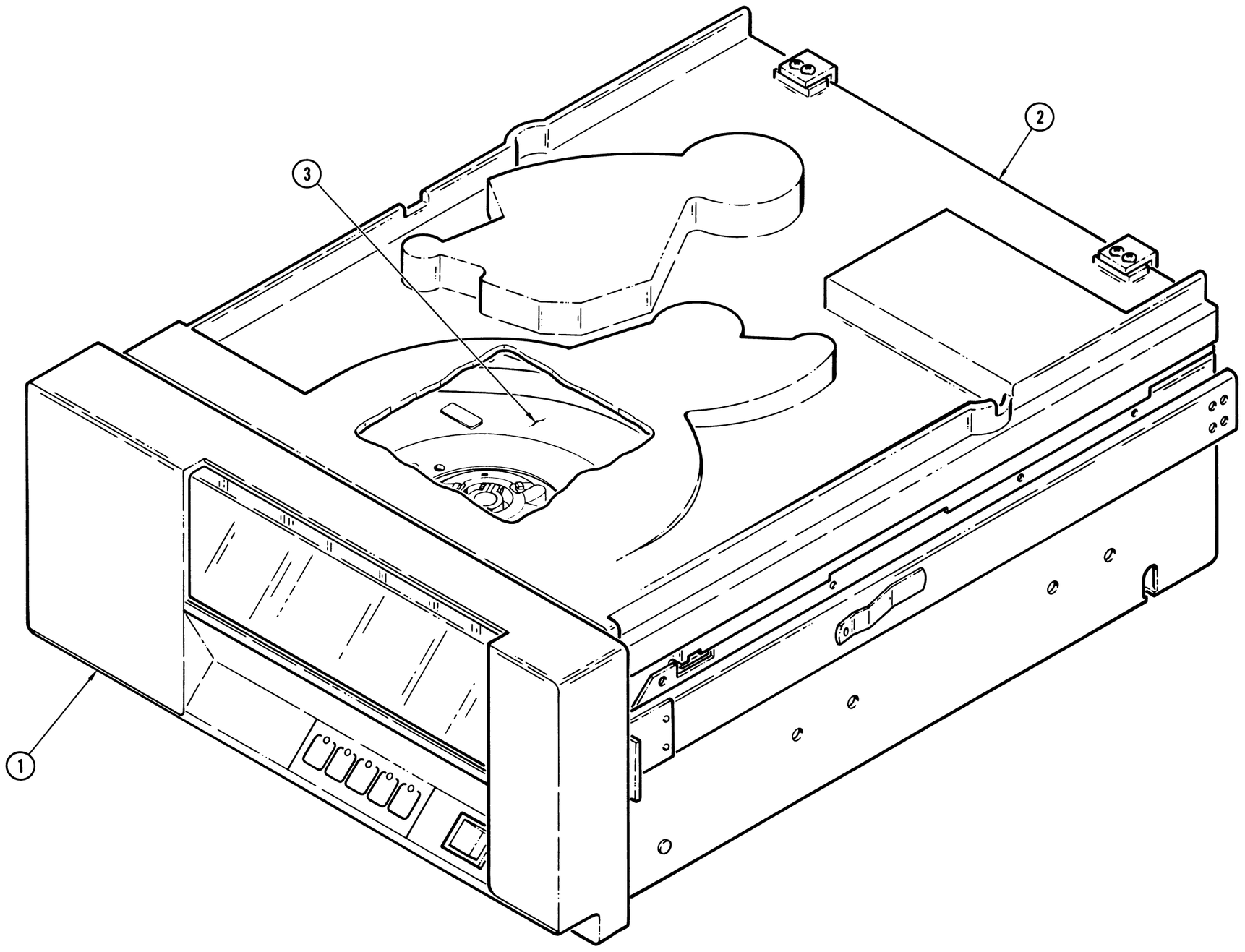

Figure 5-1. Model F880 Magnetic Tape Streamer Unit (Assembled View)

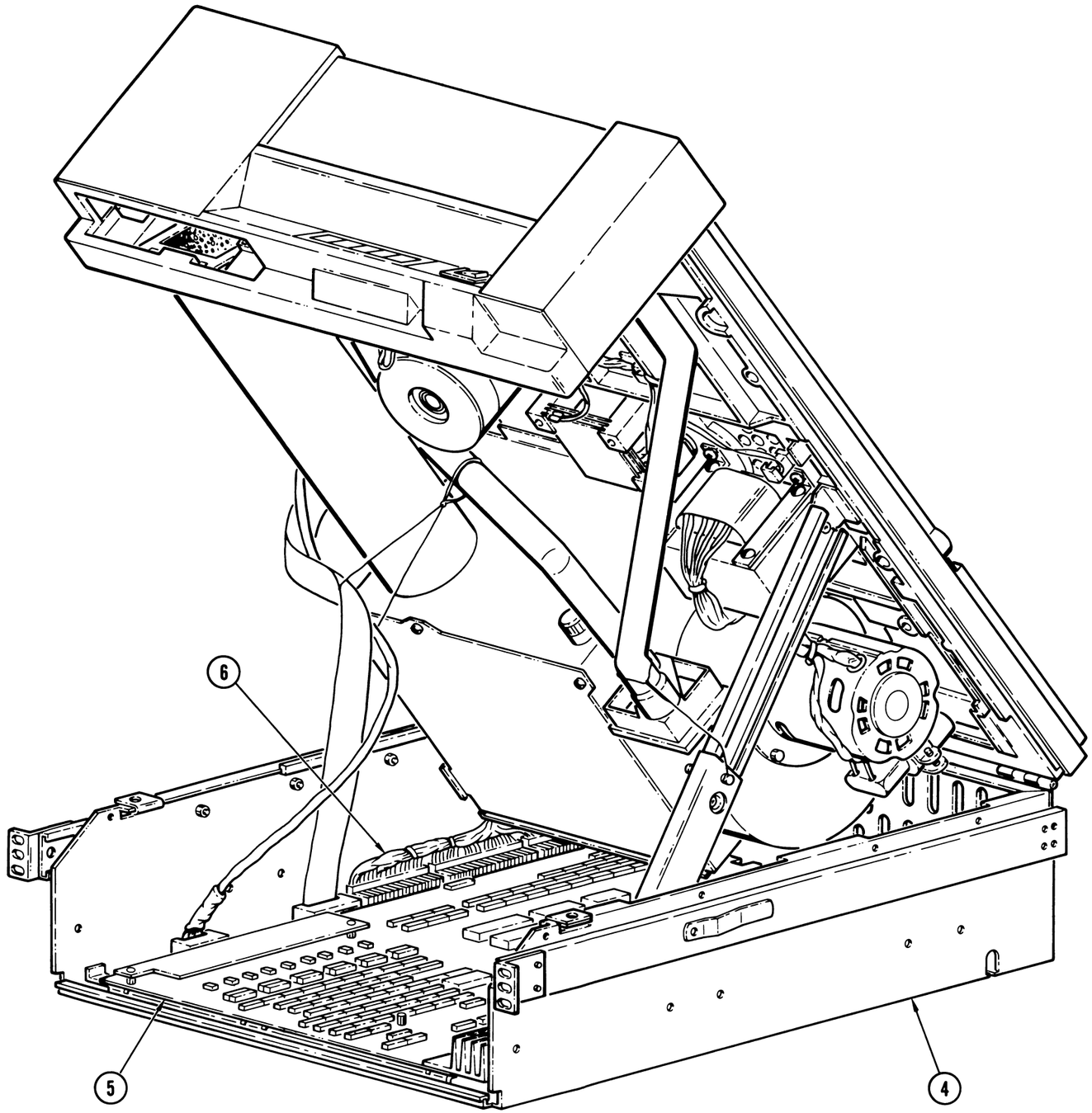

Figure 5-1. Model F880 Magnetic Tape Streamer Unit (Assembled View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-1	960670-001 960672-001	MAGNETIC TAPE TRANSPORT, ... Model F880 (Assembled View) (See Figure 5-2)	REF REF	A B
-1	960359-001	. FRONT PANEL ASSEMBLY (Exploded View) ..... (See Figure 5-3)	1	
-2	960057-001	. TOP COVER ASSEMBLY (Exploded View)..... (See Figure 5-4)	1	
-3	960567-001	. BASIC DRIVE ASSEMBLY (Exploded View)..... (See Figure 5-5)	1	
-4	960566-001	. CHASSIS ASSEMBLY (Exploded View)..... (See Figure 5-6)	1	
-5	960719-001	. PRINTED WIRING BOARD ASSEMBLY, ... Drive/Formatter, 25, 50, 100 ips (Exploded View) (See Figure 5-7)	1	B
	960757-001	. PRINTED WIRING BOARD ASSEMBLY, ... Drive/Formatter, 100, 25 ips (Exploded View) (See Figure 5-7)	1	A
-6	960629-001	. HARNESS ASSEMBLY (Exploded View)..... (See Figure 5-8)	1	

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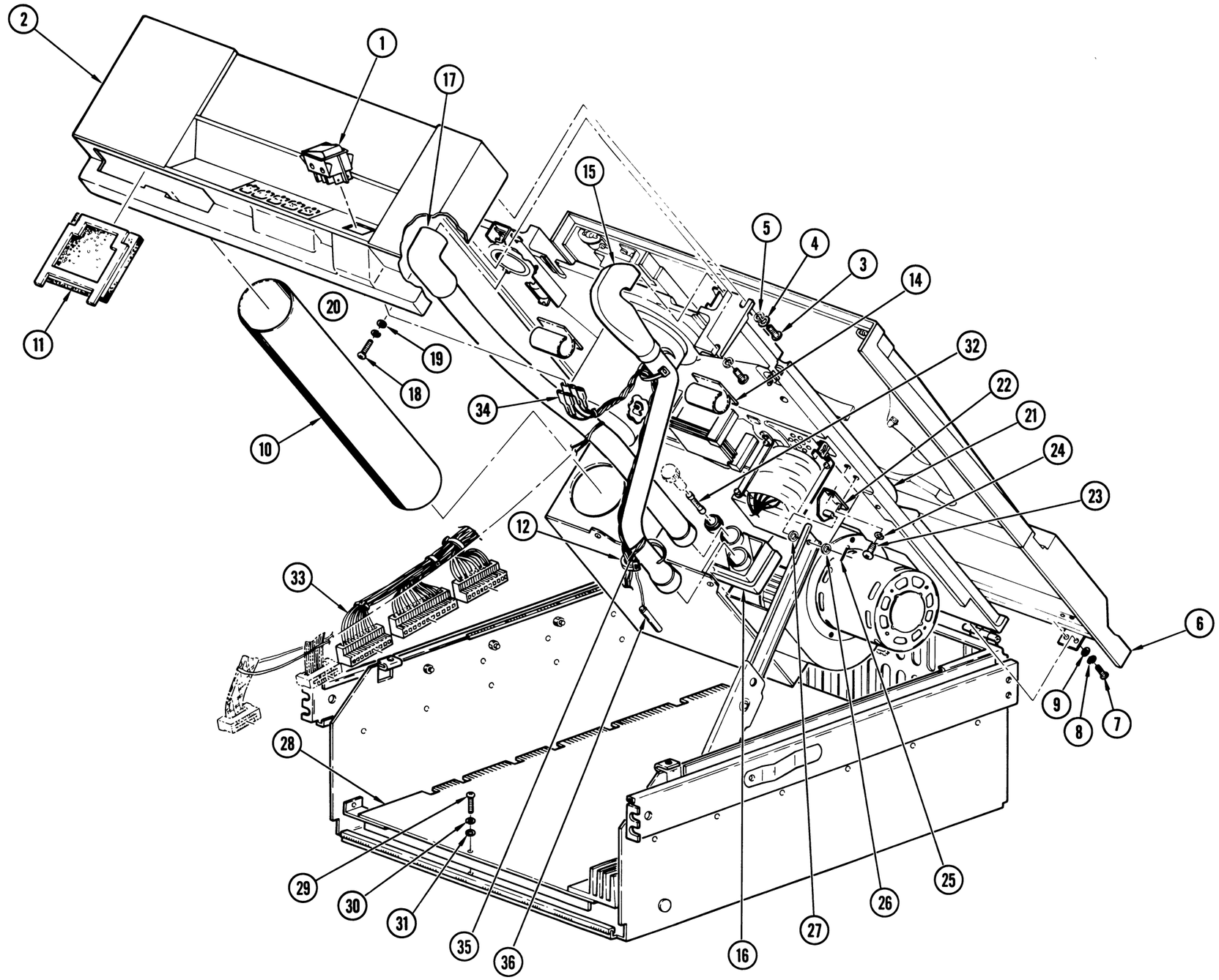

Figure 5-2. Model F880 Magnetic Tape Streamer Unit (Exploded View)

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FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2	960670-001	MAGNETIC TAPE TRANSPORT, Model ..... F880, 25/100 ips, phase encode, 100/125V	REF	A
	960672-001	MAGNETIC TAPE TRANSPORT, Model F880,..... 25/50/100 ips, phase encode, 100//125V	REF	B
-1	760105-570	. SWITCH, Power, DPST, lighted 16A, 250V,..... UL, CSA, VDE	1	
-2	960359-001	. FRONT PANEL ASSEMBLY ..... (See Figure 5-3 for breakdown)	1	
		(ATTACHING PARTS)		
-3	213271-108	. SCREW, Pan head, phillips..... 10-32 x 1/2 in. lg, cadmium plated, black, zinc	4	
-4	207104-021	. WASHER, Flat, No. 10	4	
-5	207102-011	. WASHER, Split lock, No. 10	4	
		-- -- -- * -- -- --		
-6	960057-001	. TOP COVER ASSEMBLY ..... (See Figure 5-4 for breakdown)	1	
		(ATTACHING PARTS)		
-7	213271-605	. SCREW, Pan head, phillips..... 6-32 x 5/16 in. lg, cadmium plated, black zinc	4	
-8	207602-011	. WASHER, Split lock, No. 6	4	
-9	207608-021	. WASHER, Flat, small OD, No. 6.....	4	
		-- -- -- * -- -- --		
-10	760101-795	. . AIR DUCT (Tube)	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2				
-11	960027-001	. FILTER, Air	1	
-12	210229-516	. TY-RAP, 8 in	2	
-13		. NOT USED		
-14	970457-001	. CABLE CLAMP, adhesive backed	3	
-15	160107-478	. DUCT, Air, front panel	1	
-16	760101-609	. NOZZLE, Blower	1	
-17	760106-554	. DUCT, Air, top plate	1	
		(ATTACHING PARTS)		
-18	213271-805	. SCREW, Pan head, phillips, 8-32 x 5/16 in. lg, cadmium black, zinc	1	
-19	207801-021	. WASHER, Flat, No. 8	1	
-20	207802-011	. WASHER, Split lock, No. 8	1	
-21	960567-001	. BASIC DRIVE ASSEMBLY (See Figure 5-5 for breakdown)	1	
-22	760101-660	. BRACKET, Support, top plate assembly	1	
		(ATTACHING PARTS)		
-23	213271-106	. SCREW	2	
-24	207102-011	. WASHER, Split lock, No. 10	2	
-25	205042-509	. PIN, Cotter, 1/16 x 1/2 in. lg	1	
-26	207104-021	. WASHER, Flat, No. 10	1	
-27	961084-001	. SPACER	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2				
-28	960757-001	. PRINTED WIRING BOARD ASSEMBLY, ... Drive/Formatter, 100, 25 ips (See Figure 5-7 for breakdown)	1	A
	960719-001	. PRINTED WIRING BOARD ASSEMBLY..... Drive/Formatter, 25, 50, 100 ips (See Figure 5-7 for breakdown)	1	B
		(ATTACHING PARTS)		
-29	213274-606	. SCREW, Pan head, phillips, ... 6-32 x 3/8 in. lg	1	
-30	207602-011	. WASHER, Split lock, No. 6	1	
-31	207605-021	. WASHER, Flat, No. 6	1	
		-- -- -- * -- -- --		
-32	211151-330	. FUSE, 3AG, slo-blo, 3 amp	1	
-33	960629-001	. HARNESS ASSEMBLY (See Figure..... 5-8 for breakdown)	1	
-34	160105-453	. HARNESS ASSEMBLY, Power switch	1	
-35	970134-001	. LANYARD, Elastic.....	1	
-36	760105-519	. PIN, Safety.....	1	

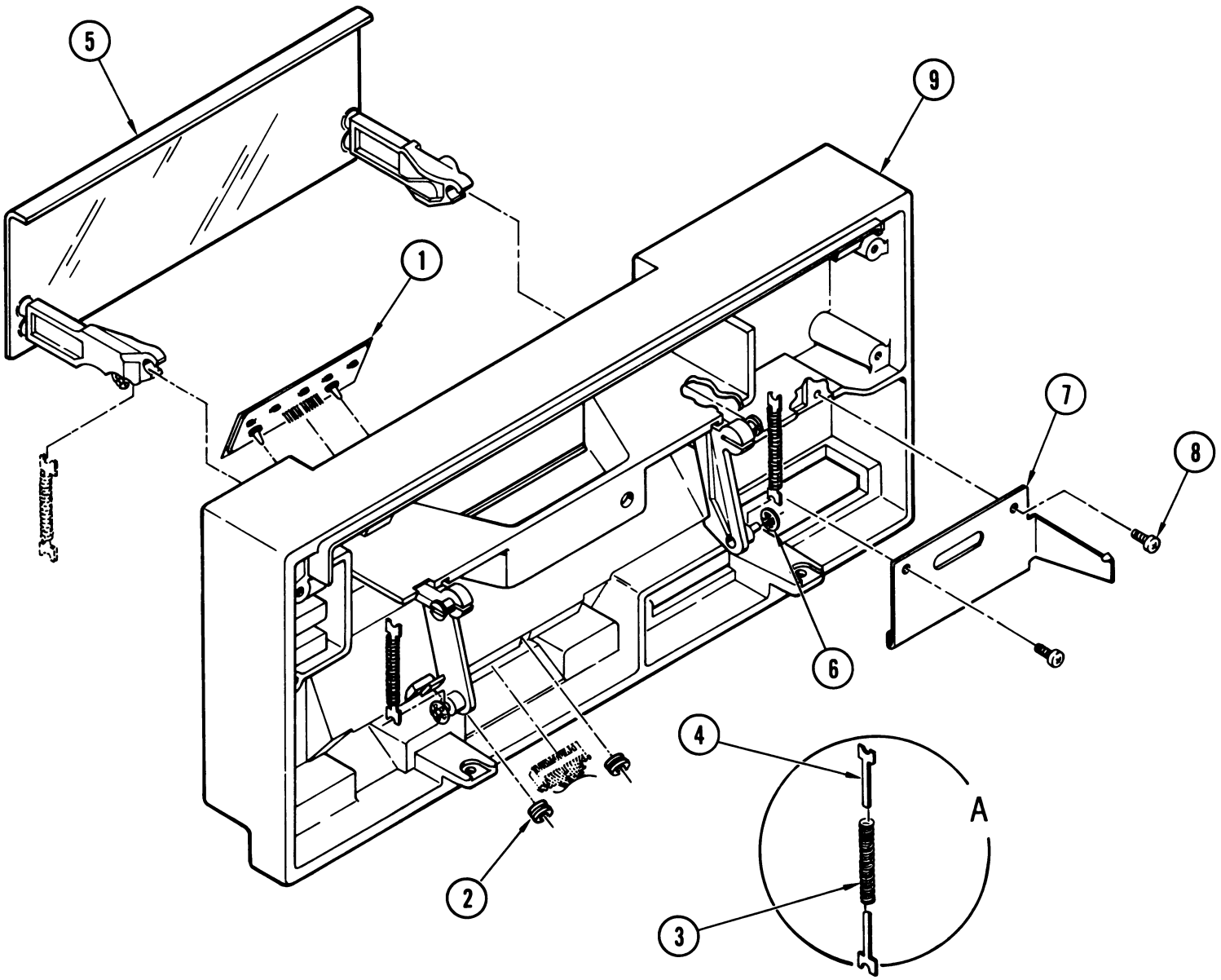


Figure 5-3. Front Panel Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-3	960359-001	FRONT PANEL ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	760102-595	. TOUCH SWITCH, Tactile response.....	1	
-2	210200-016	. RING, Retaining, push-on	2	
-3	210001-013	. SPRING, Compression, 5-lb.....	2	
-4	760101-591	. GUIDE, Spring	4	
-5	160101-451	. DOOR ASSEMBLY	1	
-6	210200-016	. RING, Retaining, push-on	2	
-7	760101-531	. LATCH, Rack	1	
		(ATTACHING PARTS)		
-8	970263-606	. SCREW, Pan head, phillips, ... 6-32 x 3/8 in. lg., cadmium plated, black, zinc	2	
		-- -- -- * -- -- --		
-9	760102-662	. FRONT PANEL, Painted	1	

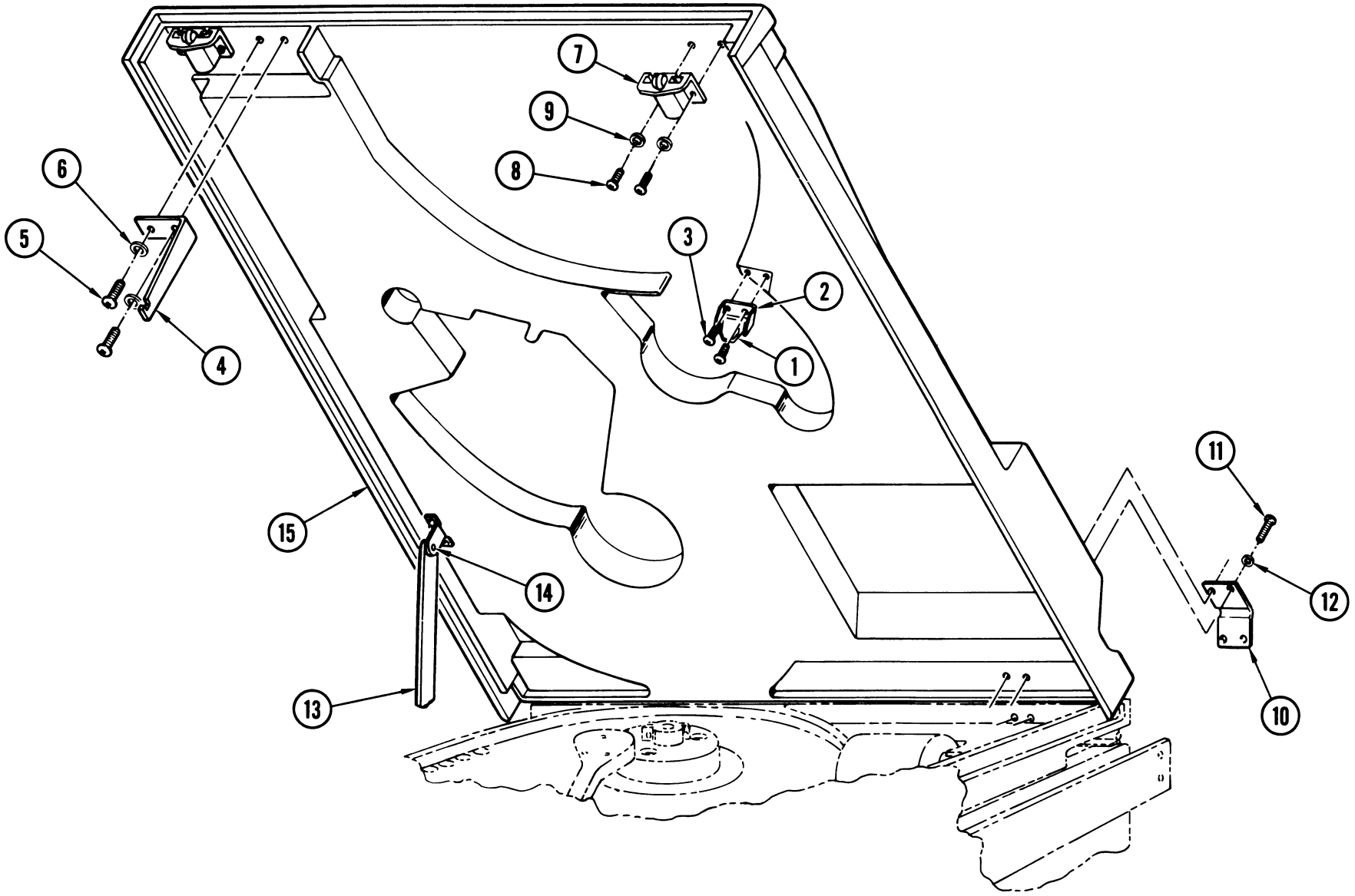


Figure 5-4. Top Cover Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4	960057-001	TOP COVER ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	760101-825	. DEFLECTOR TAPE, diecast	1	
-2	760102-585	. BRACKET, Tape deflector	1	
		(ATTACHING PARTS)		
-3	213921-404	. SCREW, Pan head, phillips, ... 4-24 x 1/4 in. lg	2	
		-- -- -- * -- -- --		
-4	760101-580	. TAB, Cover lock	1	
		(ATTACHING PARTS)		
-5	970263-606	. SCREW, Pan head, phillips..... 6-18 x 3/8 in. lg, cadmium, black, zinc	2	
-6	207605-021	. WASHER, Flat, No. 6	2	
		-- -- -- * -- -- --		
-7	210104-911	. CATCH, Roller	2	
		(ATTACHING PARTS)		
-8	213921-406	. SCREW, Pan head, phillips..... 4-40 x 3/8 in. lg, cadmium, black, zinc	4	
-9	207402-021	. WASHER, Flat, No. 4	4	
		-- -- -- * -- -- --		
-10	760103-507	. HINGE, Rear, molded.....	2	
		(ATTACHING PARTS)		
-11	213921-610	. SCREW, Pan head, phillips..... 6-20 x 5/8 in. lg	4	
-12	207605-021	. WASHER, Flat, small OD, No. 6.....	4	
		-- -- -- * -- -- --		

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4				
-13	960052-001	. . LID STAY, Relieved	1	
		(ATTACHING PARTS)		
-14	205003-005	. . PIN, Groove, 0.1875 x 0.625 in. lg	1	
		-- -- -- * -- -- --		
-15	760104-502	. . TOP COVER.....	1	

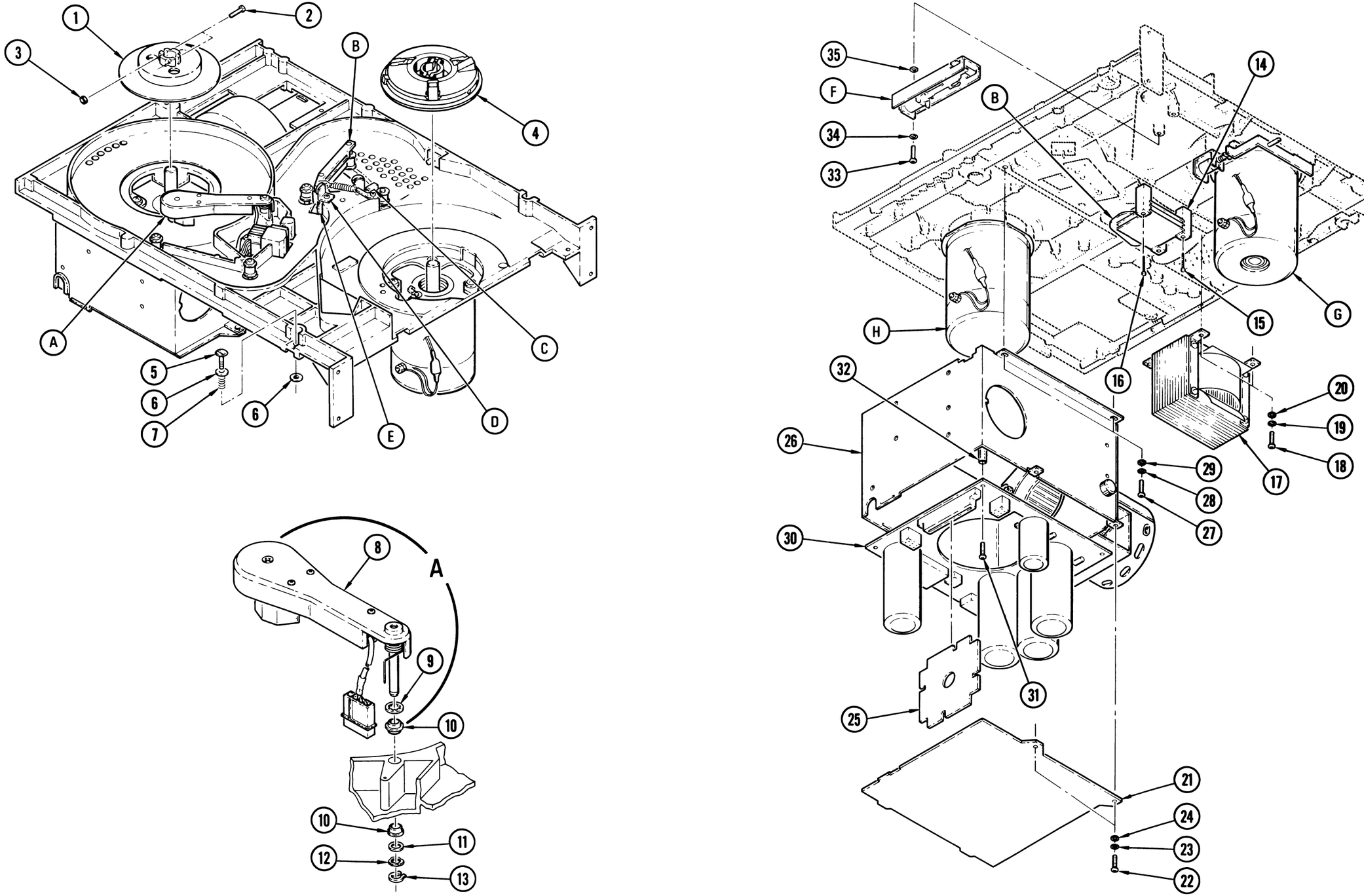
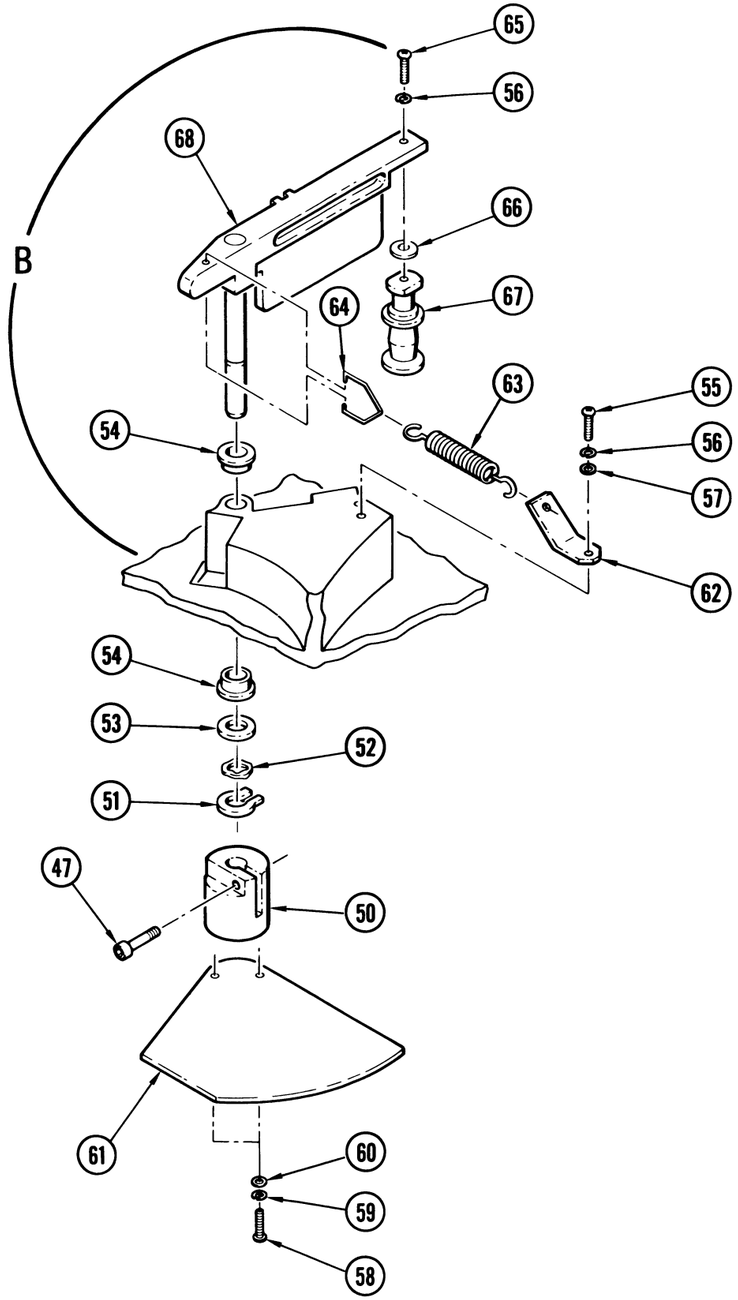
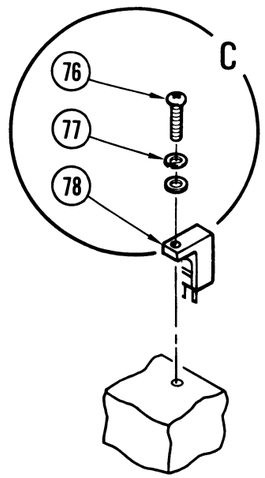


Figure 5-5. Basic Drive Assembly (Exploded View)

Figure 5-5
Sheet 1 of 4





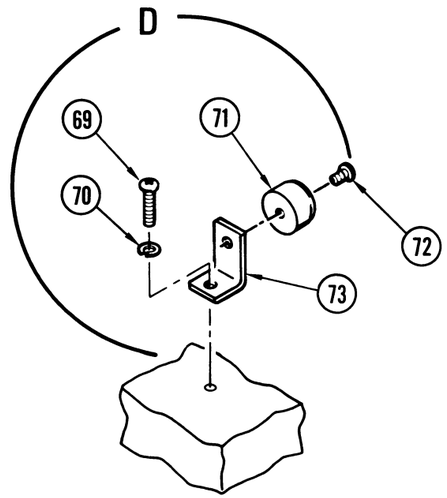
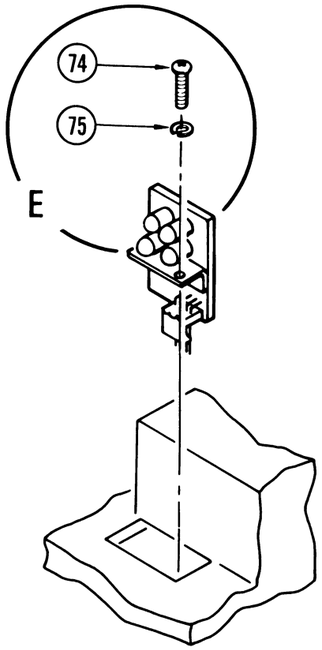


Figure 5-5. Basic Drive Assembly (Exploded View)



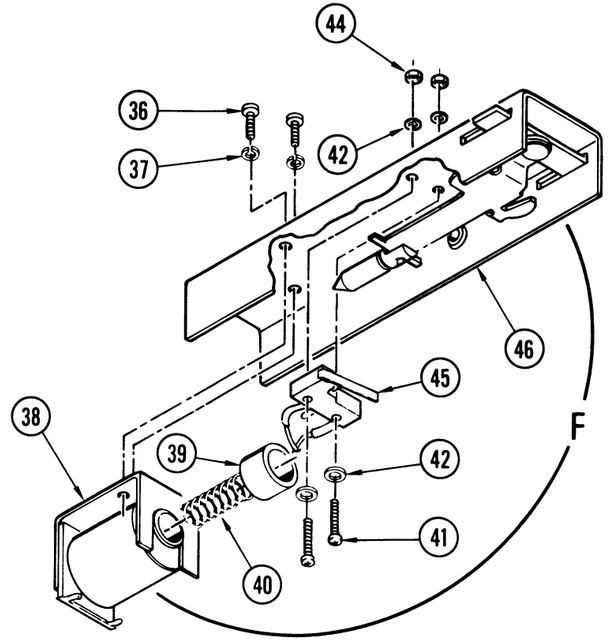
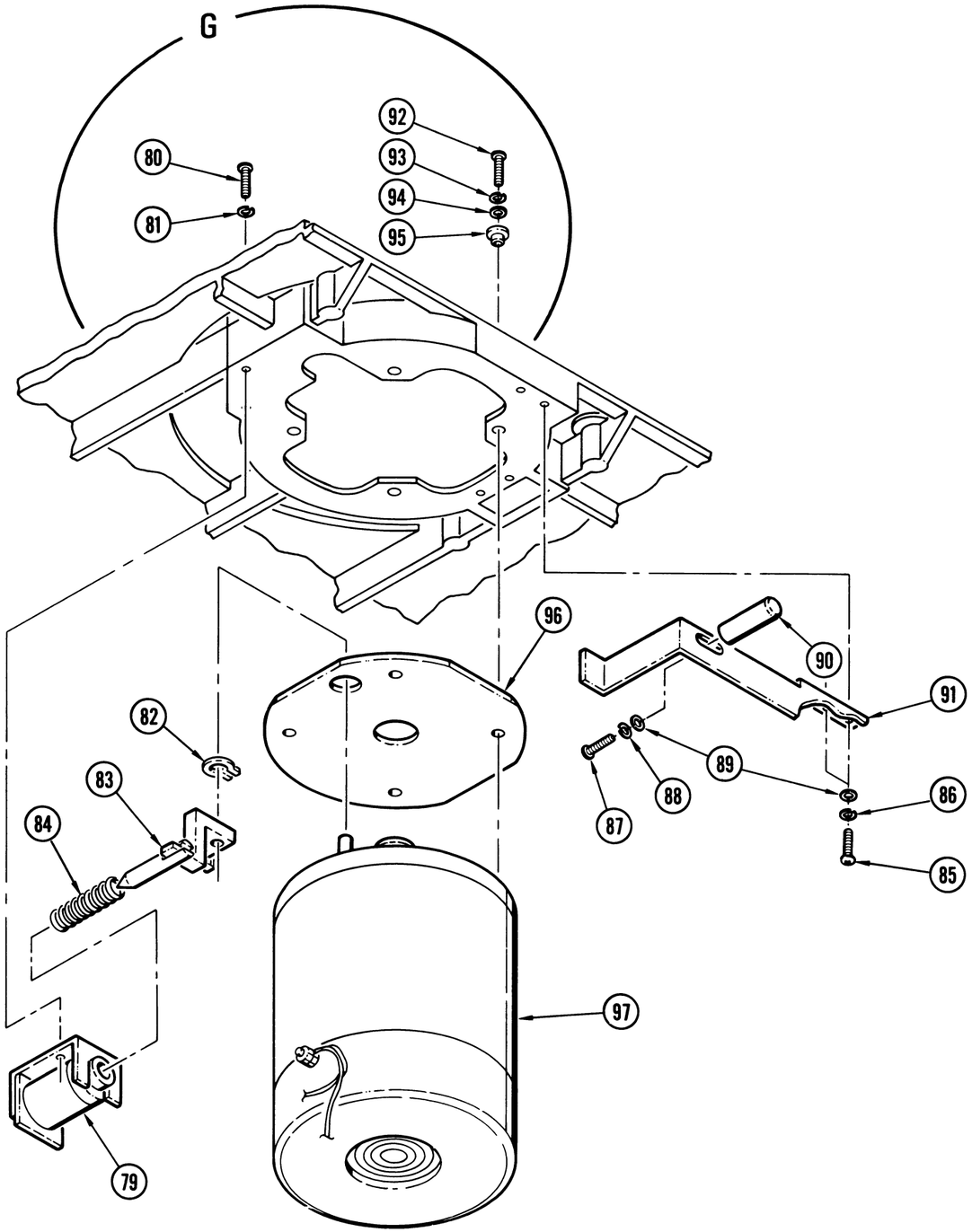


Figure 5-5
Sheet 2 of 4



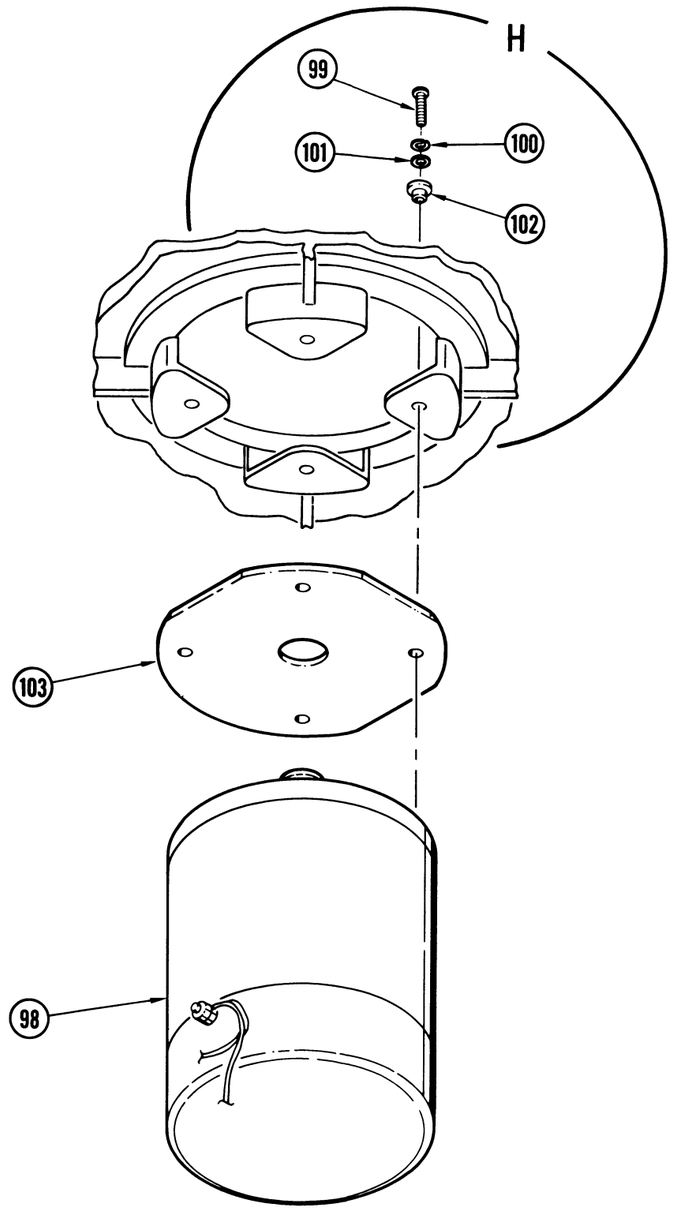
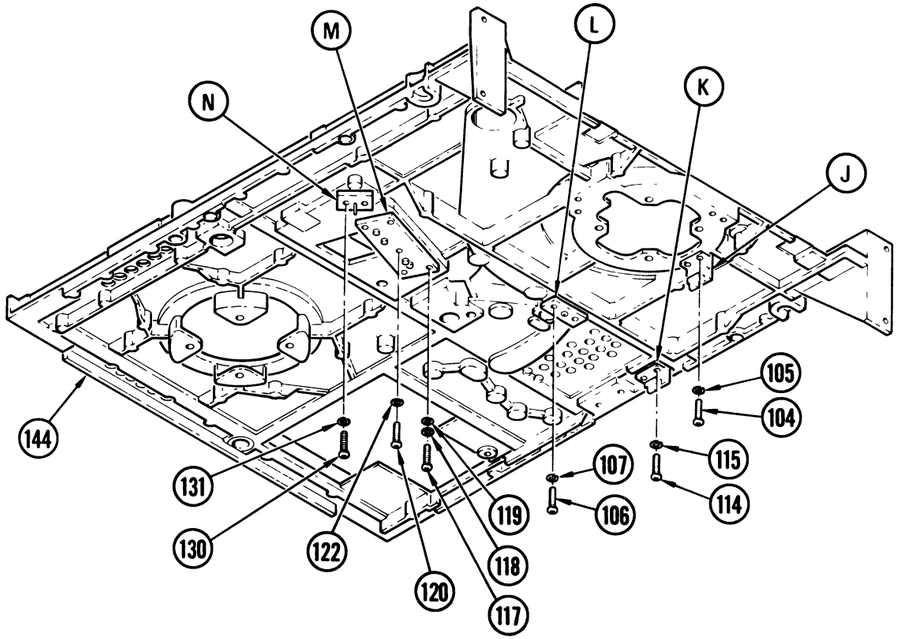
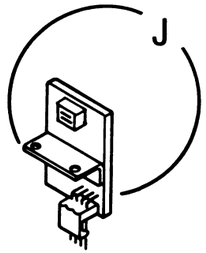
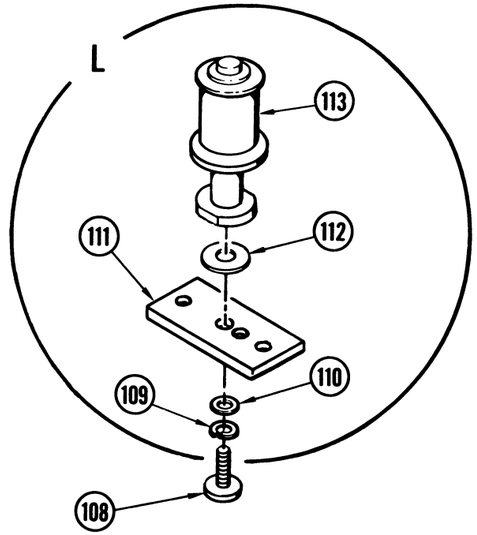
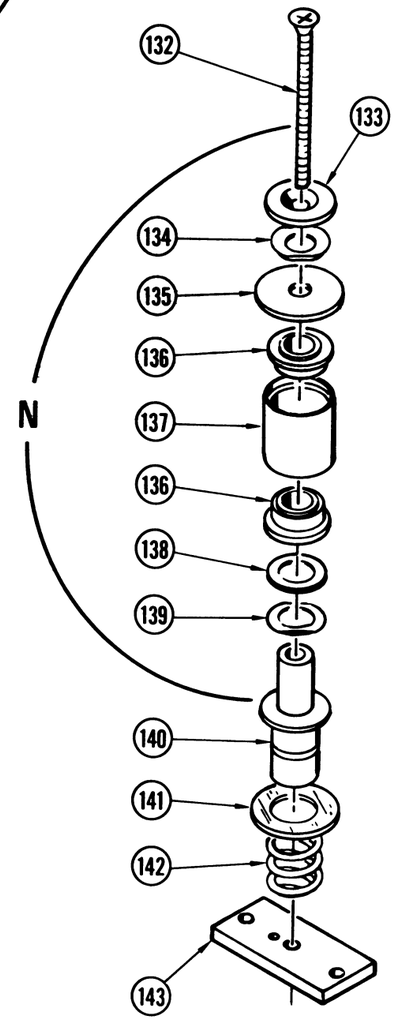


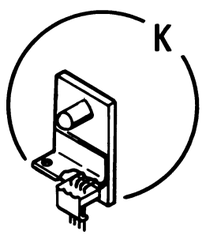
Figure 5-5. Basic Drive Assembly (Exploded View)











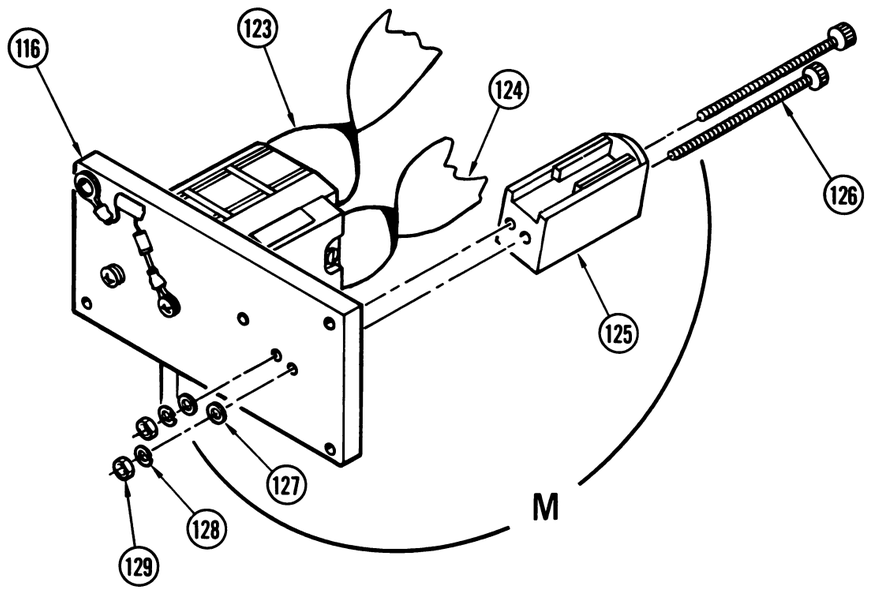


Figure 5-5. Basic Drive Assembly (Exploded View)

Figure 5-5
Sheet 4 of 4

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5	960567-001	BASIC DRIVE ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	760106-567	. HUB, Takeup	1	
		(ATTACHING PARTS)		
-2	213091-614	. SCREW, Socket head cap, ... 6-32 x 7/8 in. lg	2	
-3	207607-051	. NUT, Hex, 6-32, No. 6	2	
		-- -- -- * -- -- --		
-4	160101-406	. SUPPLY HUB ASSEMBLY ..... (See Figure 5-10 for breakdown)	1	
-5	213599-000	. SCREW, Captive, quick opening	2	
-6	210116-026	. FASTENER RETAINER	2	
-7	210004-006	. SPRING, Compression, fastener	2	
-8	160105-433	. TACHOMETER ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-9	210200-037	. RING, Retaining, Push-On.....	1	
-10	210067-001	. BEARING, 1/4 x 3/8 in.	2	
-11	731911-102	. SHIM, .005 in. thick, 1/4 in. ID	AR	
-12	210008	. WASHER, Wave spring	1	
-13	210200-032	. RING, Grip, 1/4 in. ID	1	
		-- -- -- * -- -- --		

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-14	160101-471	. CAPACITOR PLATE ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-15	213091-408	. SCREW, Socket head, cap ..... 4-40 x 1/2 in. lg, cadmium, black zinc	1	
-16	213091-410	. SCREW, Socket head, cap ..... 4-40 x 5/8 in. lg, cadmium, black zinc	2	
		-- -- -- * -- -- --		
-17	160106-402	. TRANSFORMER ASSEMBLY	1	A,B
	960199-002	. TRANSFORMER ASSEMBLY	1	C
		(ATTACHING PARTS)		
-18	213271-106	. SCREW, Pan head, phillips, ... 10-32 x 3/8 in. lg, cadmium plated, black, zinc	4	
-19	207102-011	. WASHER, Split lock, No. 10	4	
-20	207104-021	. WASHER, Flat, No. 10	4	
		-- -- -- * -- -- --		
-21	960015-001	. COVER ASSEMBLY, Power supply housing.....	1	
		-- -- -- * -- -- --		
		(ATTACHING PARTS)		
-22	213271-605	. SCREW; Pan head, phillips..... 6-32 x 5/16 in. lg, cadmium, black zinc	2	
-23	207602-011	. WASHER, Split lock, No. 6	2	
-24	207605-021	. WASHER, Flat, No. 6	2	
		-- -- -- * -- -- --		
-25	760102-102	. PWB VOLTAGE SELECT	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-26	960292-001	. POWER SUPPLY HOUSING ASSEMBLY ..... (See Figure 5-9 for breakdown)	1	A,B
	960292-002	. POWER SUPPLY HOUSING ASSEMBLY ..... (See Figure 5-9 for breakdown)	1	C
		(ATTACHING PARTS)		
-27	213091-106	. SCREW, Socket head, cap,..... 10-32 x 3/8 in. lg, cadmium plated, black, zinc	4	
-28	207102-011	. WASHER, Split lock, No. 10	4	
-29	207104-021	. WASHER, Flat, No. 10	4	
		-- -- -- * -- -- --		
-30	960298-001	. PWB ASSEMBLY, Power Supply	1	A,B
	960415-001	. PWB ASSEMBLY, Power Supply	1	C
		(ATTACHING PARTS)		
-31	213621-606	. SCREW, Socket set, knurled cup pt,..... 6-32 x 3/8, cadmium, black,zinc	4	
-32	210030-250	. STANDOFF, 1/4 Hex, 1, 6-32	4	
		-- -- -- * -- -- --		
	160101-418	. DOOR LOCK ASSEMBLY	2	
		(ATTACHING PARTS)		
-33	213271-607	. SCREW, Pan head, phillips..... 6-32 x 7/16 in. lg, cadmium plated, black, zinc	2	
-34	207602-011	. WASHER, Split lock, No. 6	2	
-35	207605-021	. WASHER, Flat, No. 6	2	
		-- -- -- * -- -- --		

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-36	213271-602	. SCREW, Pan head, phillips..... 6-32 x 3/16 in. lg, cadmium plated, black, zinc	2	
-37	207602-011	. WASHER, Split lock, No. 6	2	
-38	760101-840	. SOLENOID, Coil	1	
-39	760106-512	. SOLENOID, Spacer	1	
-40	760101-704	. SPRING, Compression	1	
-41	213271-206	. SCREW, Pan head, phillips..... 2/56 x 1/2, in. lg, cadmium plated black, zinc	2	
-42	207202-021	. WASHER, Flt, No. 2	4	
-43		NOT USED		
-44	213884-300	. NUT, Tinnerman	2	
-45	211015-011	. SWITCH, Lever, quick disconnect.....	1	
-46	760101-579	. BRACKET, Door lock.....	1	
	160103-499	. COMPLIANCE ARM ASSEMBLY	1	
		(ATTACHING PARTS)		
-47	213092-608	. SCREW, Socket head set,..... 6-32 x 1/2 in. lg, black	1	
-48		. NOT USED		
-49		. NOT USED		
-50	960712-001	. HUB, Capacitor shutter	1	
-51	210200-032	. RING, Retaining, external, 1/4 in.	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-52	210008	. WASHER, Wave spring	1	
-53	731911-102	. SHIM, 0.005 in. thick x 1/4 in. ID	1	
-54	210067-001	. BEARING, 1/4 x 3/8 in.	2	
-55	213271-606	. SCREW, Pan head, phillips..... 6-32 x 3/8 in. lg, cadmium, black, zinc	1	
-56	207602-011	. WASHER, Split lock, No. 6	2	
-57	207605-021	. WASHER, Flat, No. 6	1	
		-- -- -- * -- -- --		
	160101-444	. CAPACITOR SHUTTER ASSEMBLY	1	
		(ATTACHING PARTS)		
-58	213271-407	. SCREW, Pan head, phillips, ... 4-40 x 7/16 in. lg, zinc	2	
-59	207403-011	. WASHER, Split lock, No. 4	2	
-60	207408-021	. WASHER, Flat, small OD, No. 4.....	2	
		-- -- -- * -- -- --		
-61	760102-575	. SHUTTER, Molded	1	
-62	760101-565	. . BRACKET, Spring, compliance arm.....	1	
-63	210006-010	. . SPRING, Extension	1	
-64	760101-554	. . CLIP, Spring.....	1	
-65	213271-607	. . SCREW, Pan head, phillips, ... 6-32 x 7/16 in. lg, cadmium, black, zinc	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-66	760104-524	. . SHIM, stainless steel.....	1	
-67	760104-500	. . TAPE GUIDE, Crowned roller, short	1	
-68	160104-492	. . ARM AND SHAFT ASSEMBLY	1	
	160106-479	. BUMPER ASSEMBLY	1	
	160106-478	. BUMPER ASSEMBLY	1	
		(ATTACHING PARTS)		
-69	213271-406	. SCREW, Pan head, phillips, ... 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-70	207403-011	. WASHER, Split lock, No. 4	2	
		-- -- -- * -- -- --		
-71	210119	. . BUMPER.....	2	
-72	213271-403	. . SCREW, Pan head, phillips, ... 4-40 x 3/16 in. lg, cadmium, black, zinc	2	
-73	760101-662	. . BRACKET, Compliance arm, stop	2	
	160101-009	. PRINTED WIRING BOARD ASSEMBLY, ... Reflective sensor, EOT/BOT	1	
		(ATTACHING PARTS)		
-74	213271-405	. SCREW, Pan head, phillips, ... 4-40 x 5/16 in. lg, cadmium, black, zinc	2	
-75	207403-011	. WASHER, Split lock, No. 4	2	
		-- -- -- * -- -- --		
	160103-433	. . SENSOR RECEIVER ASSEMBLY, Molded	1	
		(ATTACHING PARTS)		
-76	213271-406	. SCREW, Pan head, phillips, ... 4-40 x 3/8 in. lg, cadmium, black, zinc	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-77	207403-011	. WASHER, Split lock, No. 4	1	
-78	207402-021	. WASHER, Flat, No. 4	1	
		-- -- -- * -- -- --		
-79	760101-840	. SOLENOID, 24VDC continuous	1	
		(ATTACHING PARTS)		
-80	213092-612	. SCREW, Socket head, cap ..... 6-32 x 3/4 in. lg, black	2	
-81	207602-011	. WASHER, Split lock, No. 6	2	
-82	210200-001	. RING, Retaining	1	
		-- -- -- * -- -- --		
-83	760106-510	. BELLCRANK, Reel hub lock	1	
-84	760101-704	. SPRING, Compression	1	
	960930-001	. BRACKET, Hub Unlock	1	
		(ATTACHING PARTS)		
-85	213274-404	. SCREW, Pan head, phillips, ... 4-40 x 1/4 in. lg, cadmium plated, black, zinc	2	
-86	207403-011	. WASHER, Split lock, No. 4	2	
		-- -- -- * -- -- --		
-87	213274-404	. . SCREW, Pan head, phillips, ... 4-40 x 1/4 in. lg, cadmium plated, black, zinc	1	
-88	207403-011	. . WASHER, Split lock, No. 4	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-89	207402-021	. . WASHER, Flat, No. 4	3	
-90	760101-629	. . PIN, Reel hub unlock	1	
-91	760101-622	. . BRACKET, Spring, reel hub unlock	1	
	160101-497	. SUPPY MOTOR ASSEMBLY	1	
		(ATTACHING PARTS)		
-92	213271-107	. SCREW, Pan head, phillips, ... 10-32 x 7/16 in. lg, cadmium plated, black, zinc	4	
-93	207102-011	. WASHER, Split lock, No. 10	4	
-94	213704-100	. WASHER, Flat, No. 10	4	
-95	760101-768	. WASHER, Shoulder, insulating	4	
		-- -- -- * -- -- --		
-96	760101-756	. INSULATOR, Motor	1	
-97	760101-527	. MOTOR, Permanent magnet, 4 in. ..... diameter, supply	1	
-98	799031-201	. MOTOR, Permanent magnet, ... 4 in. dia, takeup	1	
		(ATTACHING PARTS)		
-99	213271-107	. SCREW, Pan head, phillips, ... 10-32 x 7/16 in. lg, cadmium plated, black, zinc	4	
-100	207102-011	. WASHER, Split lock, No. 10	4	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-101	213704-100	. WASHER, Flat, No. 10	4	
		-- -- -- * -- -- --		
-102	760101-768	. WASHER, Shoulder, insulating	4	
-103	760101-756	. INSULATOR, Motor	1	
	160101-005	. PRINTED WIRING BOARD ASSEMBLY, ... File protect	1	
		(ATTACHING PARTS)		
-104	213217-406	. SCREW, Pan head, phillips, ... 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-105	207403-011	. WASHER, Split lock, No. 4	2	
		-- -- -- * -- -- --		
	160104-401	. ROLLER GUIDE ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-106	213271-406	. SCREW, Pan head, phillips, ... 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-107	207403-011	. WASHER, Split lock, No. 4	2	
-108	213274-605	. . SCREW, Pan head, phillips, ... 6-32 x 5/16 in. lg	1	
-109	207602-011	. . WASHER, Split lock, No. 6	1	
-110	207605-021	. . WASHER, Flat, No. 6	1	
-111	760101-566	. . PLATE, Tape guide	1	
		-- -- -- * -- -- --		

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-112	760104-524	. . SHIM, Stainless steel	1	
-113	799043-201	. . ROLLER, Tape guide	1	
	160101-010	. PRINTED WIRING BOARD ASSEMBLY, ... Reflective sensor, Tape-In-Path	1	
		(ATTACHING PARTS)		
-114	213271-406	. SCREW, Pan head, phillips, ... 4-40 x 3/8 in. lg, cadmium, black, zinc	2	
-115	207403-011	. WASHER, Split lock, No. 4	2	
		-- -- -- * -- -- --		
-116	961139-001	. HEAD ASSEMBLY.....	1	
		(ATTACHING PARTS)		
-117	213271-408	. SCREW, Pan head, phillips..... 4-40 x 1/2 in. lg, cadmium plated black, zinc	4	
-118	207403-011	. WASHER, Split lock, No. 4	4	
-119	207402-021	. WASHER, Flat, No. 4	4	
-120	213092-408	. SCREW, Socket head, cap,..... 4-40 x 1/2, black	1	
-121		. NOT USED		
-122	207402-021	. WASHER, Flat, No.4.....	1	
		-- -- -- * -- -- --		
-123	961003-001	. HEAD CABLE ASSEMBLY, Read	1	
-124	960413-001	. HEAD CABLE ASSEMBLY, Write.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-125	131047-001	. . TAPE SCRAPER ASSEMBLY	1	
		(ATTACHING PARTS)		
-126	213091-407	. . SCREW, Socket head, cap,.....	2	
-127	207408-021	. . WASHER, Flat, small OD, No. 4.....	2	
-128	207403-011	. . WASHER, Split lock, No 4	2	
-129	207406-081	. . NUT, Hex, radio pattern, No. 4, 4-40.....	2	
		-- -- -- * -- -- --		
	160104-400	. ROLLER GUIDE ASSEMBLY.....	3	
		(ATTACHING PARTS)		
-130	213271-407	. SCREW, Pan head, phillips, ... 4-40 x 7/16 in. lg, cadmium plated, black, zinc	3	
-131	207403-011	. WASHER, Split lock, No. 6	3	
		-- -- -- * -- -- --		
-132	213151-424	. . SCREW, Fillister head, phillips 100 ..... 4 x 40 x 1-1/2 in. lg.	1	
-133	754004-901	. . CAP, Roller guide.....	1	
-134	210260-000	. . WASHER, Spring, crescent	1	
-135	754007-901	. . WASHER, Guide	1	
-136	210067-001	. . BEARING, 1/4 x 3/8 in.	2	
-137	760101-540	. . ROLLER, Spring guide	1	
-138	731911-101	. . SHIM, .004 thick, 1/4 in. ID.....	1	
	731911-102	. . SHIM, .005 thick, 1/4 in. ID.....	1	
	731911-105	. . SHIM, .010 thick, 1/4 in. ID.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
-139	210008	. . WASHER, Wave spring	1	
-140	760101-833	. . BASE, Roller guide	1	
-141	754007-801	. . WASHER, Guide	1	
-142	210003-038	. . SPRING, Compression	1	
-143	760101-567	. . PLATE, Tape guide	1	
-144	760106-547	. TOP PLATE	1	

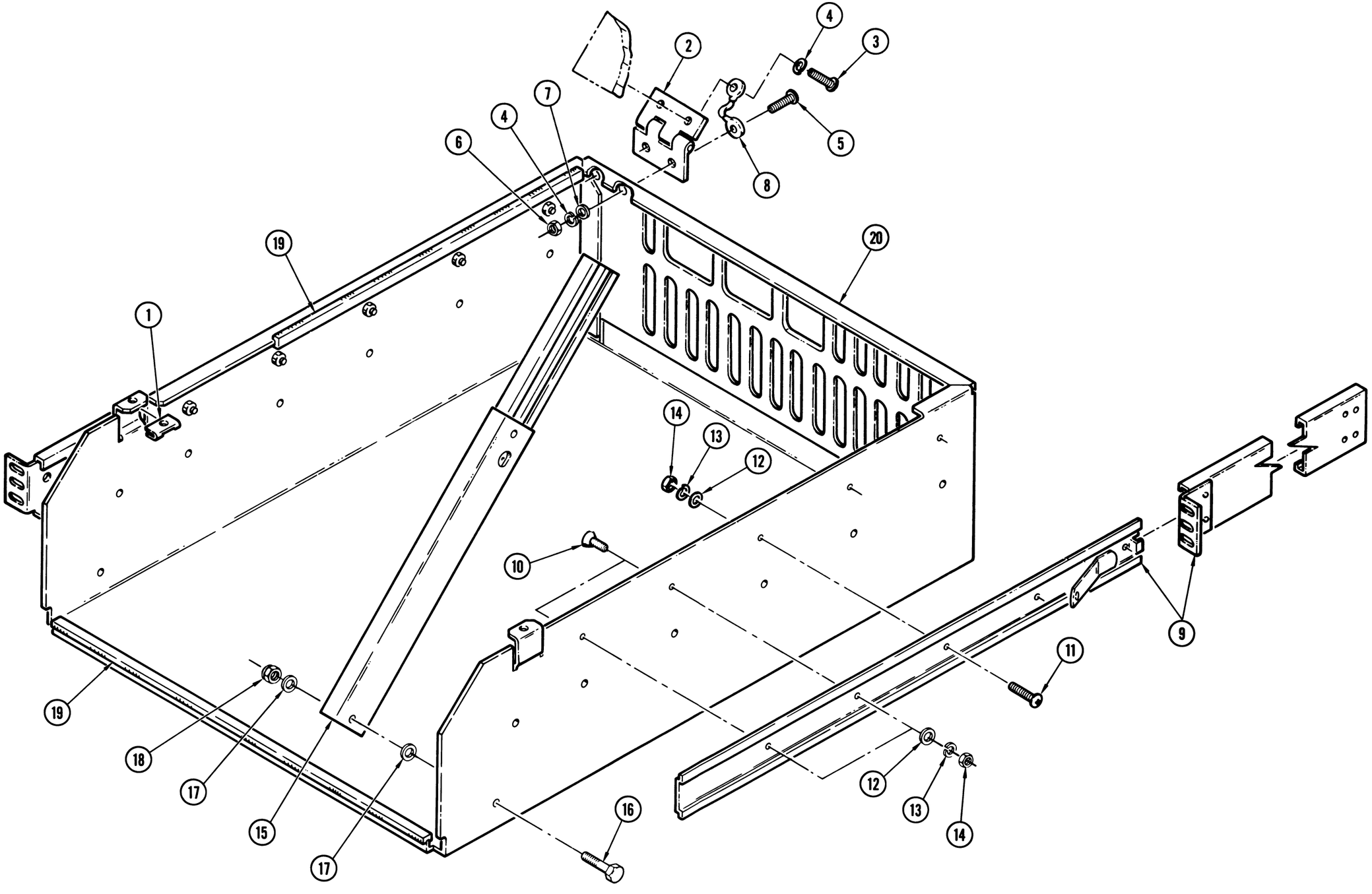


Figure 5-6. Chassis Assembly

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FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-6				
	960566-001	CHASSIS ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	210116-027	. FASTENER, Clip-on	2	
-2	760103-535	. HINGE.....	2	
-3	213271-107	. SCREW, Pan head, phillips..... 10-32 x 7/16 in. lg, cadmium black, zinc	4	
-4	207102-011	. WASHER, Split lock, No. 10	12	
-5	213271-106	. SCREW, Pan head, phillips, ... 10-32 x 3/8 in. lg, cadmium, black, zinc	4	
-6	207101-081	. NUT, Hex, radio pattern, No. 10.....	4	
-7	207104-021	. WASHER, Flat, No. 10	4	
		-- -- -- * -- -- --		
-8	960032-001	. GROUND STRAP, Chassis.....	1	
-9	960274-001	. SLIDE ASSEMBLY, Modified.....	2	
		(ATTACHING PARTS)		
-10	213151-107	. SCREW, Flat head, phillips,..... 10-32 x 7/16 in. lg, cadmium, black or zinc	2	
-11	213271-106	. SCREW, Pan head, phillips..... 10-32 x 3/8 in. lg, cadmium black or zinc	6	
-12	207104-021	. WASHER, Flat, No. 10	8	
-13	207102-011	. WASHER, Split lock, No. 10	8	
-14	207101-081	. NUT, Hex, Radio pattern, No. 10, 10-32	8	
		-- -- -- * -- -- --		
-15	160106-408	. SUPPORT ASSEMBLY, Top plate.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-6				
		(ATTACHING PARTS)		
-16	213634-108	. SCREW, Hex head, .170 grip, ... 10-32 x 1/2 in. lg	1	
-17	207104-021	. WASHER, Flat, No. 10	2	
-18	205255-002	. NUT, Lock, hex, 10-32	1	
		-- -- -- * -- -- --		
-19	205288-200	. GROMMET, Strip	2.5	
-20	960073-001	. CHASSIS, Narrow, modified	1	

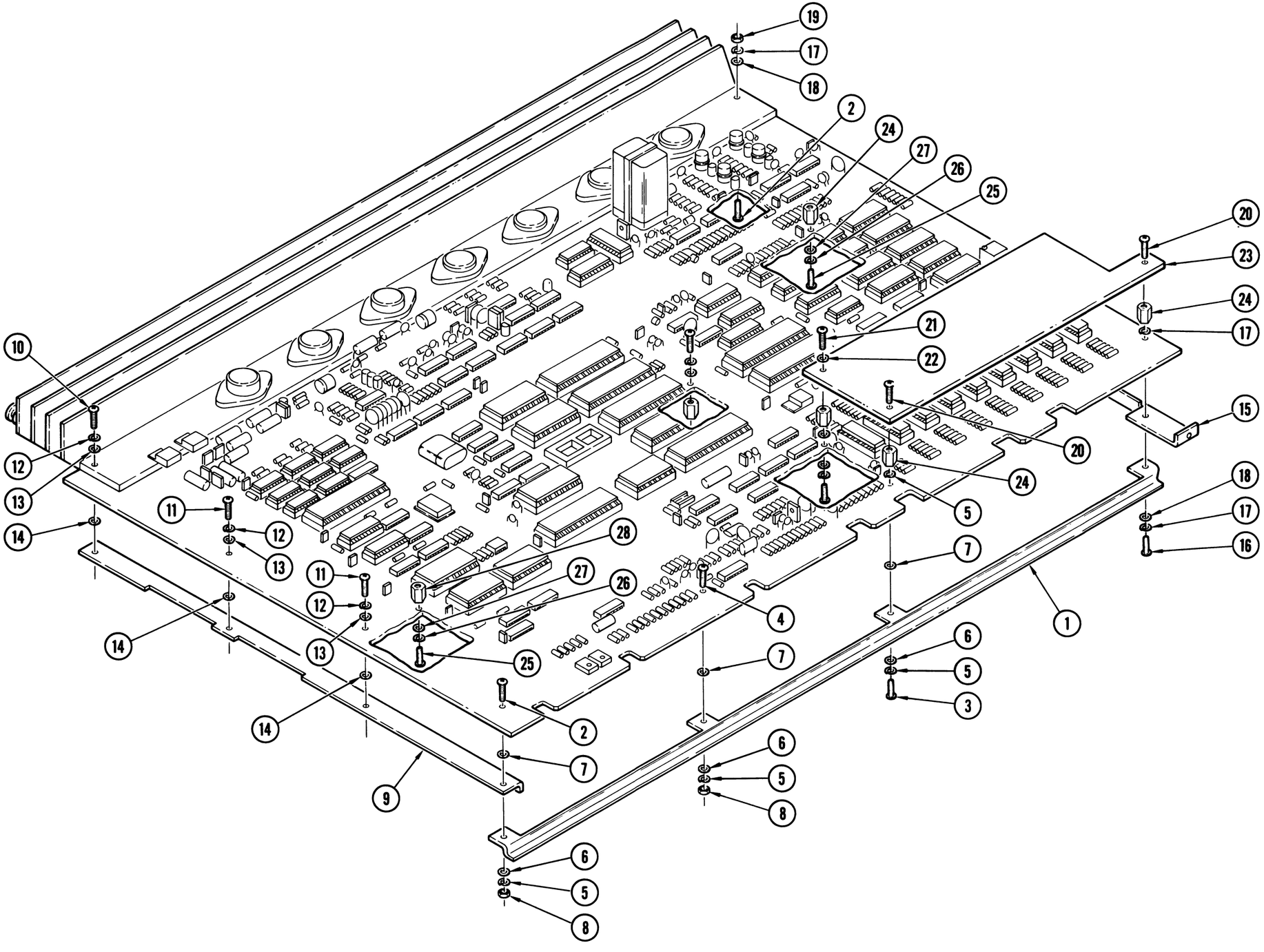

Figure 5-7. Drive Formatter Printed Wiring Board Assembly (Exploded View)

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FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-7				
	960719-001 960757-001	PRINTED WIRING BOARD ASSEMBLY, Drive..... formatter (See Figure 5-2 for next higher assembly and Figure 5-11 for breakdown)	REF	A B
-1	760101-695	. STIFFENER, Left side	1	
		(ATTACHING PARTS)		
-2	213271-609	. SCREW, Pan head, phillips..... 6-32 x 9/16 in. lg, cadmium, black, zinc	1	
-3	213271-607	. SCREW, Pan Head, phillips ..... 6-32 x 7/16, cadmium, black, zinc	1	
-4	213271-607	. SCREW, Pan head, phillips..... 6-32 x 7/16 in. lg, cadmium, black zinc	1	
-5	207602-011	. WASHER, Split lock, No. 6	4	
-6	207608-021	. WASHER, Flat, small OD, No. 6.....	3	
-7	213700-609	. WASHER, Flat, nylon, small OD, No. 6	3	
-8	207604-081	. NUT, Hex, radio pattern, 6-32	2	
		-- -- -- * -- -- --		
-9	760101-693	. STIFFENER, Rear.....	1	
		(ATTACHING PARTS)		
-10	213271-609	. SCREW, Pan head, phillips..... 6-32 x 9/16 in. lg, cadmium black, zinc	1	
-11	213274-606	. SCREW, Pan head, phillips..... 6-32 x 3/8 in. lg, cadmium, black, zinc	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-7				
-12	207602-011	. WASHER, Split lock, No. 6	3	
-13	207608-021	. WASHER, Flat, small OD, No. 6.....	3	
-14	213700-609	. WASHER, Flat, Nylon, small OD, No. 6.....	3	
-15	760102-543	. STIFFENER, Front	1	
		(ATTACHING PARTS)		
-16	213271-607	. SCREW, Pan head, phillips, ... 6-32 x 7/16 in. lg, cadmium, black, zinc	1	
-17	207602-011	. WASHER, Split lock, No. 6	3	
-18	207608-021	. WASHER, Flat, small OD, No. 6.....	2	
-19	207604-081	. NUT, Hex, radio pattern, 6-32	1	
-20	210016-006	. SCREW, nylon, 6-32 x 1/4	2	
-21	213271-604	. SCREW, Pan head, phillips.....	1	
-22	207602-011	. WASHER, Split lock, No. 6	1	
-23	760101-803	. SHIELD.....	1	
-24	210030-632	. STANDOFF, 1/4 in. hex, A/F, ... 3/8 in., 6-32	5	
		(ATTACHING PARTS)		
-25	213274-606	. SCREW, Pan head, phillips..... 6-32 x 3/8 in. lg	5	
-26	207602-011	. WASHER, Split lock, No. 6	5	
-27	207608-021	. WASHER, Flat, small OD, No. 6.....	5	
		-- -- -- * -- -- --		
-28	210030-141	. STANDOFF, 1/4 hex, ... 7/16 IN., 6-32	1	

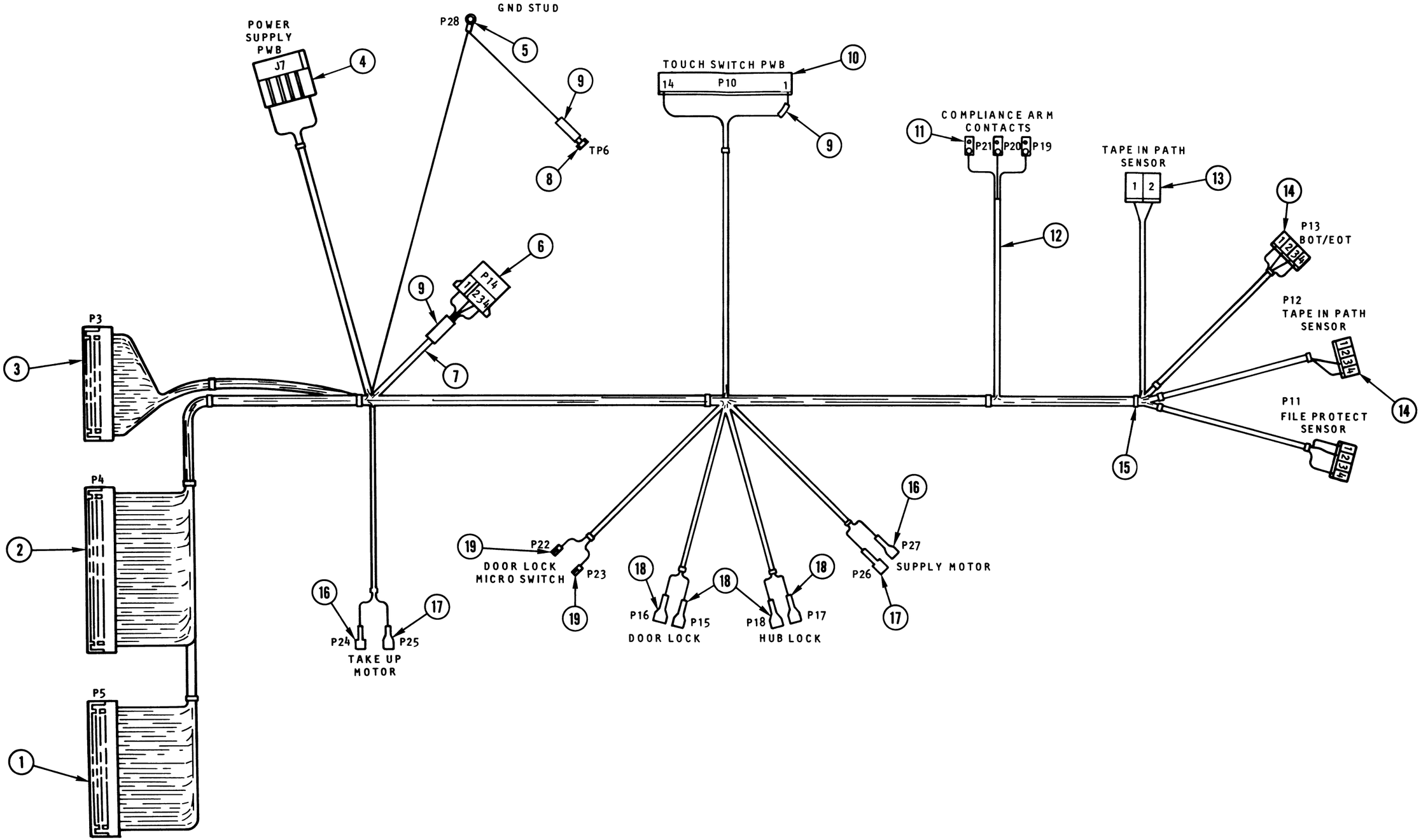

Figure 5-8. Harness Assembly

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FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-8	960629-001	HARNESS ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	970302-018	. CONNECTOR, Printed circuit, right ..... angle, 18-pin, without flanges	1	
-2	970302-022	. CONNECTOR, Printed circuit, right ..... angle, 22-pin, without flanges	1	
-3	970302-015	. CONNECTOR, Printed circuit, right ..... angle, 15-pin, without flanges	1	
-4	205071-500	. CONNECTOR, 15-position.....	1	
-5	210905	. LUG, Ring, No. 6.....	1	
-6	205107	. CONNECTOR, 4-position.....	1	
-7	208500-032	. CABLE, Shielded, 4-conductor, 24 AWG	AR	
-8	210575-611	. PIN, Receptacle, reel.....	1	
-9	210408-006	. TUBING, Heat shrink, black	AR	
-10	970121-001	. CONNECTOR, 14-position, ID	1	
-11	760101-729	. CONTACT, Capacitive plate.....	3	
-12	208500-041	. CABLE, Shielded, 2-conductor	2	
-13	970123-001	. CONNECTOR, 2-position, lock insulate	1	
-14	970122-001	. CONNECTOR, 4-position, lock..... insulated, disp/plzd ramp	3	
-15	210229-527	. TY-RAP, 1/32 in., 4 in. lg	52	
-16	210555-077	. TERMINAL, Nylon coupler, 22-18AWG	2	
-17	210555-078	. TERMINAL, 250x032 male, 22-18 gauge, ... fully insulated	2	
-18	210555-036	. TERMINAL, Slip-on, 0.187 tab, reel.....	4	
-19	210578-100	. TERMINAL, 0.093 tab, non-insulated.....	2	

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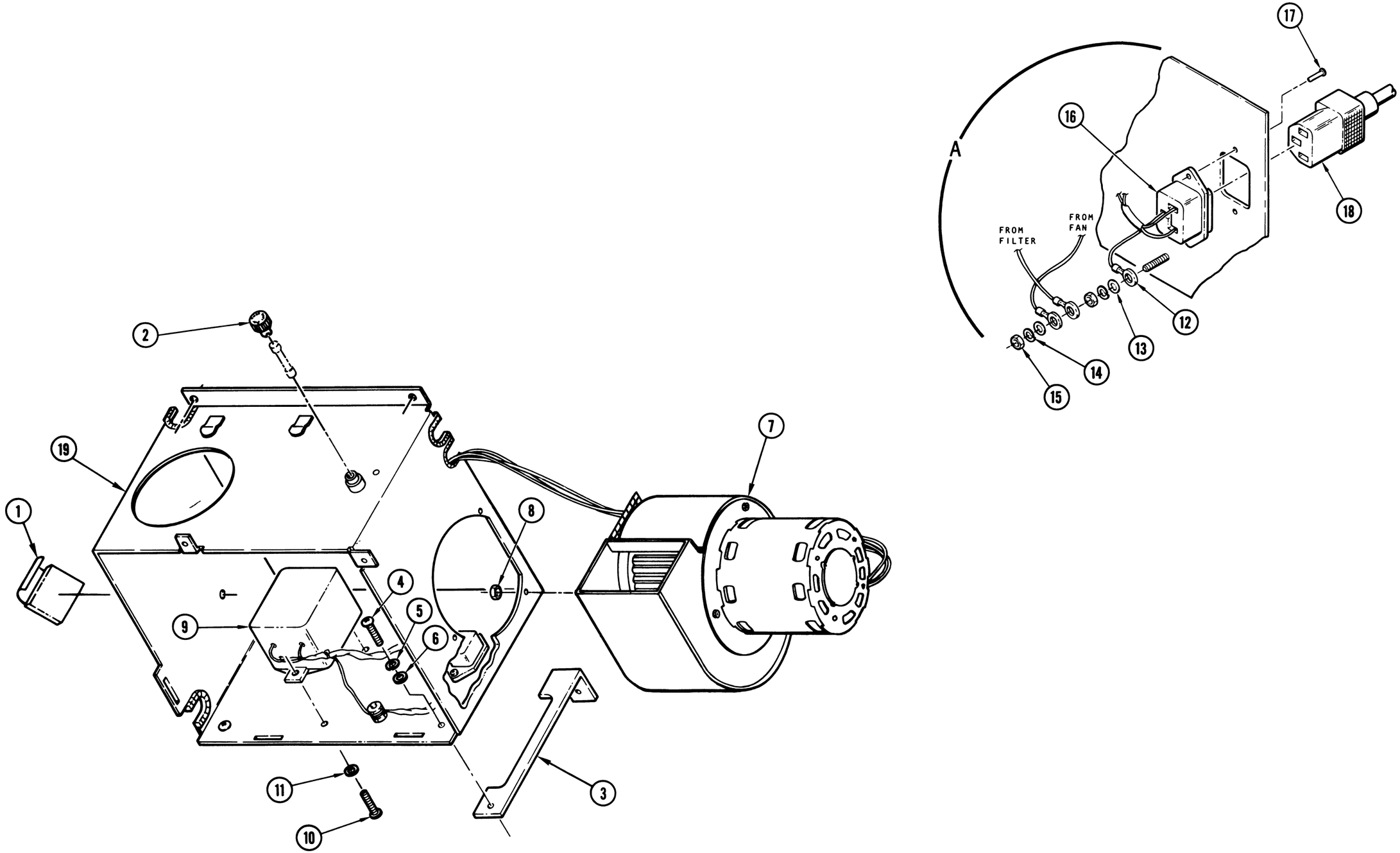

Figure 5-9. Power Supply Housing Assembly

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FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-9	960292-001	HOUSING ASSEMBLY, Power Supply Assembly..... (See Figure 5-5 for next higher assembly)	REF	A,B
	960292-002	HOUSING ASSEMBLY, Power Supply Assembly..... (See Figure 5-5 for next higher assembly)	REF	C
-1	970457-001	. CABLE CLAMP, adhesive backed.....	1	
-2	799016-401	. FUSEHOLDER, Panel.....	1	
-3	760106-540	. BRACKET	2	
		(ATTACHING PARTS)		
-4	213092-106	. SCREW, Socket head cap..... 10-32 x 3/8 in lg, black only	2	
-5	207102-011	. WASHER, Split lock, No. 10	2	
-6	207104-021	. WASHER, Flat, No. 10	2	
-7	160105-439	. AIR PUMP ASSEMBLY.....	1	A,B
	960488-001	. AIR PUMP ASSEMBLY.....	1	C
		(ATTACHING PARTS)		
-8	970219-012	. NUT, Hex, No. 8-32, Locking	3	
		-- -- -- * -- -- --		
-9	960294-001	. FILTER, ASSEMBLY, IEC	1	
		(ATTACHING PARTS)		
-10	213271-606	. SCREW, Pan head, phillips, ... 6-32 x 3/8 in lg, cadmium, black or zinc	2	
-11	207605-021	. WASHER, Flat, No. 6	2	
		-- -- -- * -- -- --		
-12	210555-027	. TERMINAL, Ring ..... 22-16 AWG, No. 8	3	
-13	207801-021	. WASHER, Flat, No. 8	2	
-14	207802-011	. WASHER, Split lock, No. 8	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-9				
-15	207803-051	. NUT, Hex, No. 8, 8-32	2	
-16	960412-001	. RECEPTACLE ASSY	1	
		(ATTACHING PARTS)		
-17	970099-001	. RIVET, Pop, 1.8 in. dia	2	
		-- -- -- * -- -- --		
-18	970035-005	. POWER CORD, AC Line	1	
-19	960293-001	. HOUSING, Power Supply	1	

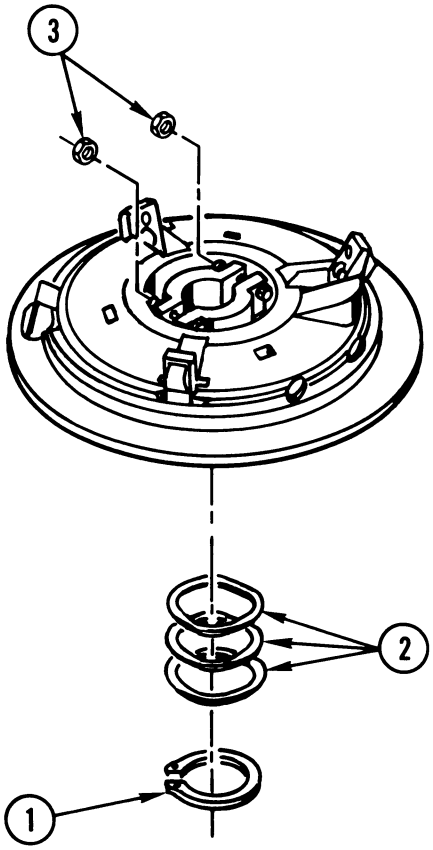


Figure 5-10. Supply Hub Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-10	160101-406	SUPPLY HUB ASSEMBLY ..... (See Figure 5-5 for next higher assembly)	REF	
-1	210200-087	. RING, Retaining, external ..... 7/8 in. ID	1	
-2	210009	. SPRING, Wave, No. 30	3	
		(ATTACHING PARTS)		
-3	207607-051	. NUT, Hex, No. 6	2	
		-- -- -- * -- -- --		

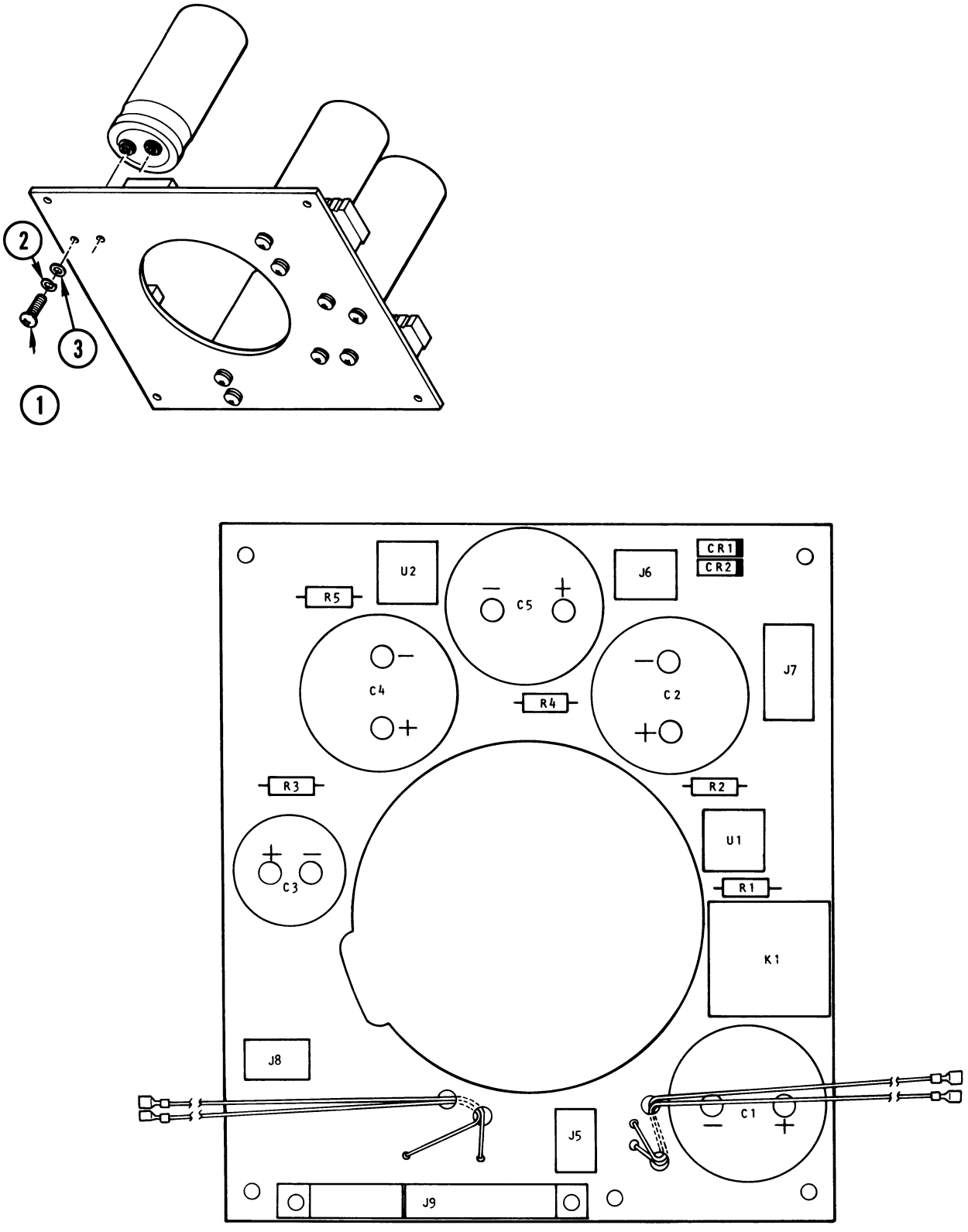


Figure 5-11. Power Supply Printed Wiring Board Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-11	960298-001	PRINTED WIRING BOARD ASSEMBLY..... Power supply, (See Figure 5-9 for next higher assembly)	REF	
C1, C2	201174-250	. CAPACITOR, Electrolytic, 25000uF,..... 30V	2	
C3	201174-160	. CAPACITOR, Electrolytic, 16000uF,..... 15v	1	
C4, C5	201174-181	. CAPACITOR, Electrolytic, 19000-..... 21000uF, 40 Vdc	2	
		(ATTACHING PARTS)		
-1	213271-106	. SCREW, Pan head, phillips..... 10-32 x 3/8 in. lg, cadmium black, zinc	10	
-2	207105-031	. WASHER, Internal lock, No. 10.....	10	
-3	207108-021	. WASHER, Flat, small OD, No. 4.....	10	
		-- -- -- * -- -- --		
CR1, CR2	202009-751	. DIODE, Rectifier, 6A, 12V	2	
J5	205195-200	. CONNECTOR, Socket assembly, ... 6-position	1	
J6	205064	. CONNECTOR, 9-position.....	1	
J7	205070	. CONNECTOR HOUSING, 15-position	1	
J8	205195-300	. CONNECTOR, Socket assembly 6-position	1	
J9	205108-023	. CONNECTOR, Printed circuit ..... edge, 9-position	1	
K1	970098-001	. RELAY, Opto isolated, printed circuit	1	
R1-5	200093-150	. RESISTOR, FC, 1.5K, 1W, ±5%.....	5	
U1, U2	202003-100	. RECTIFIER BRIDGE, 10 AMP.....	2	

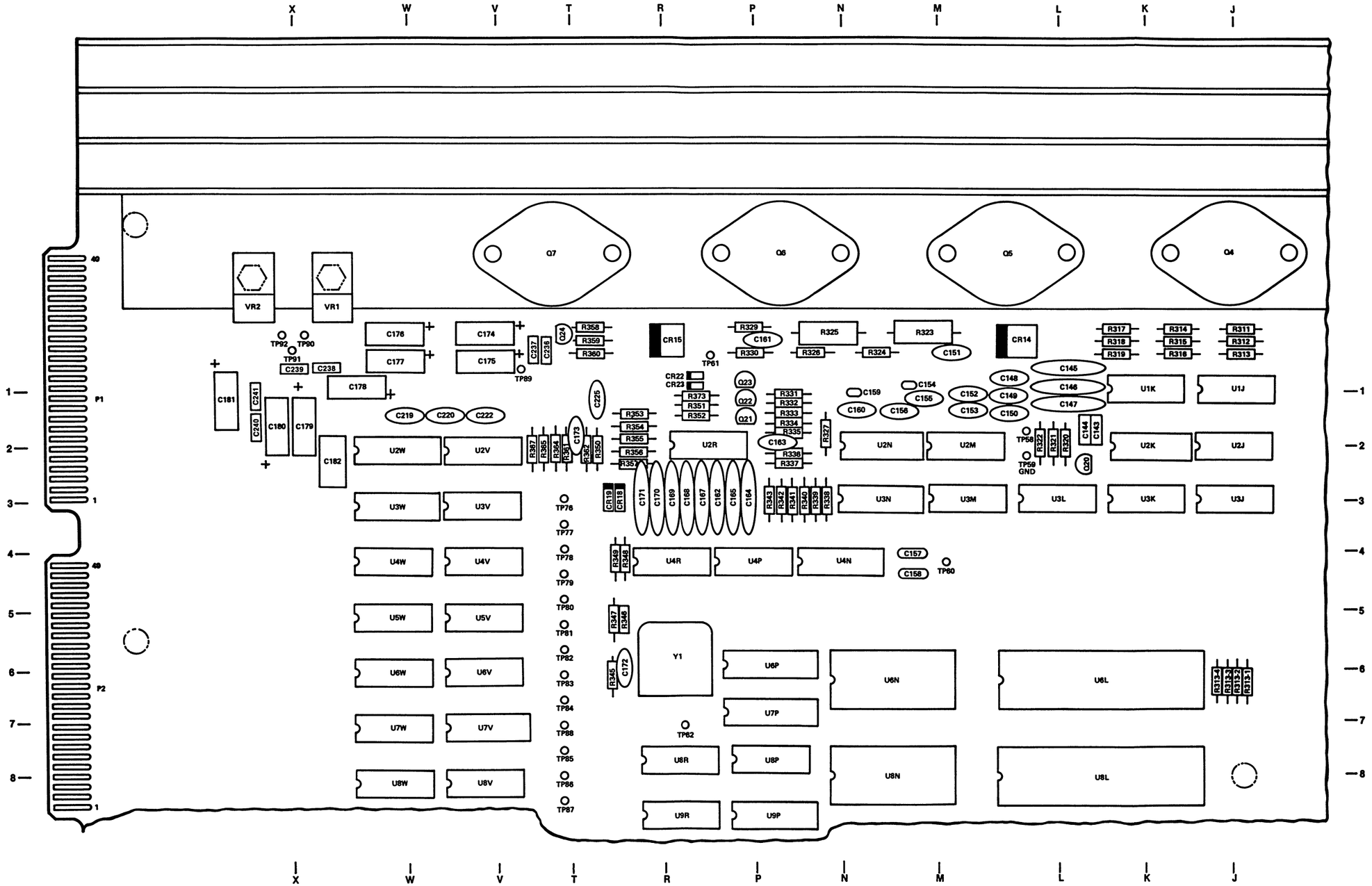


Figure 5-12. Drive Formatter PWB
(Orthographic View)

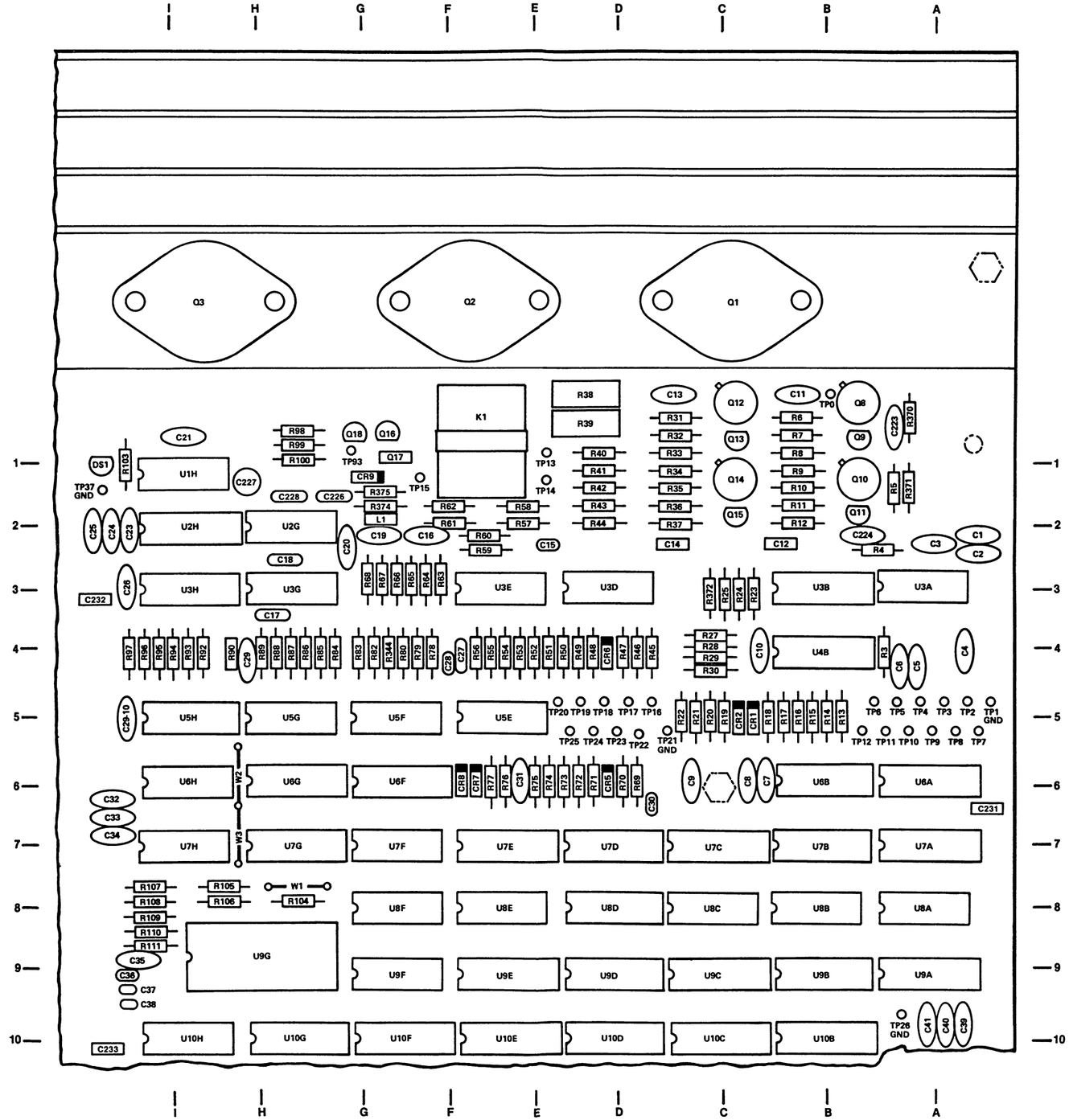


Figure 5-12. Drive Formatter PWB
(Orthographic View)

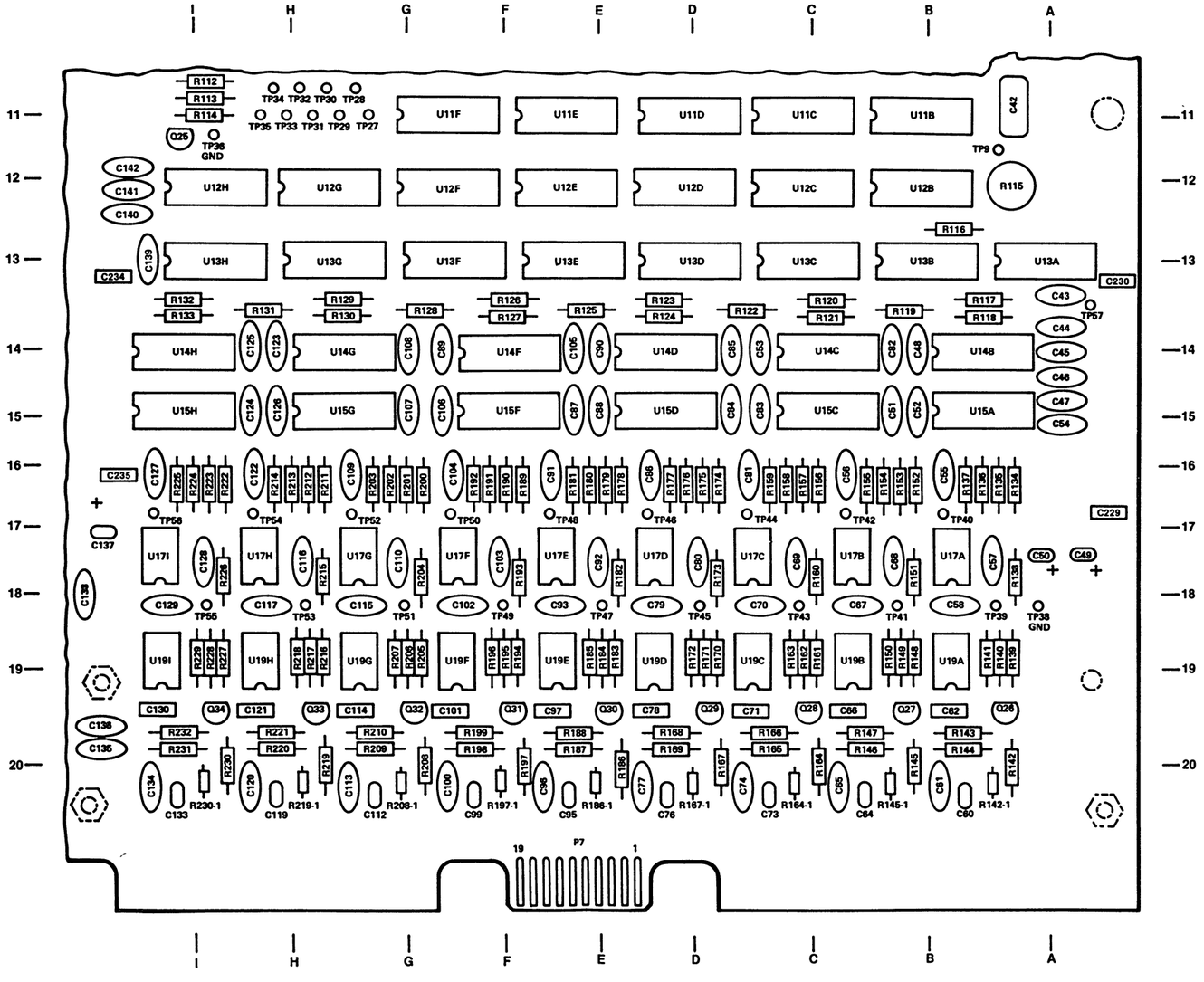


Figure 5-12. Drive Formatter PWB
(Orthographic View)

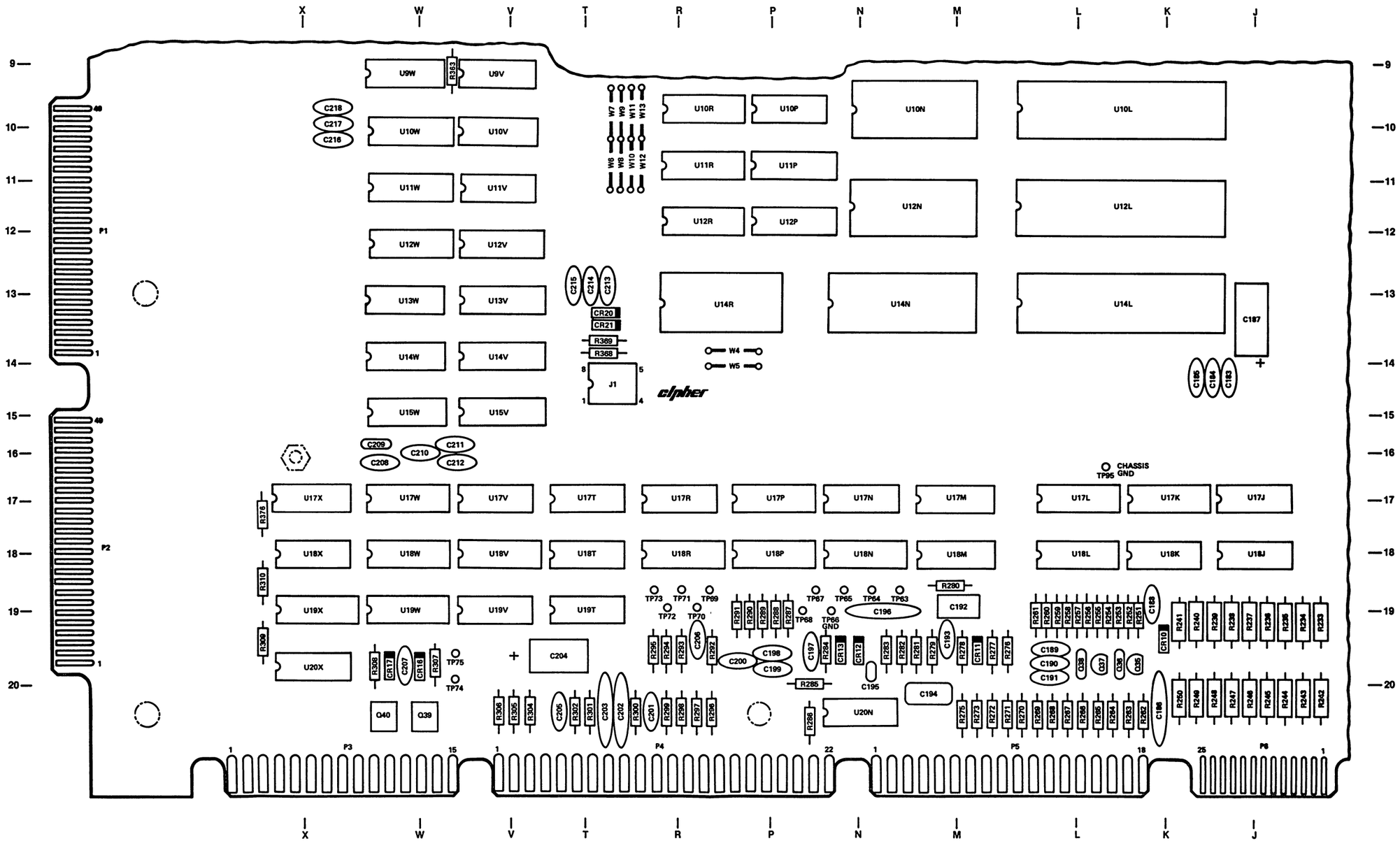


Figure 5-12. Drive Formatter PWB
(Orthographic View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12	960757-001	PRINTED WIRING BOARD ASSEMBLY, ... Subassembly, drive-formatter (See Figure 5-7 for next higher assembly)	REF	A
	960719-001	PRINTED WIRING BOARD ASSEMBLY (The following components are listed in alpha-numeric sequence according to their reference designation. Consult the schematic for location in the circuit.)		B
C1	201215-100	. CAPACITOR, Ceramic, 100 000 pF ..... ±10%, 50 V	1	
C2, C3	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C4	201105-111	. CAPACITOR, Ceramic, 0.1 uF ..... ±20%, 16 V	2	
C5, C6	201114-154	. CAPACITOR, Ceramic, 0.0015 uF ..... ±10%, 50 V	2	
C7-C9	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	3	
C10	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C11	201109-200	. CAPACITOR, Ceramic, 200 pF..... ±10%, 10 000 V	1	
C12	201105-330	. CAPACITOR, Ceramic, 0.33 uF ..... ±10%, 50 V	1	
C13	201109-200	. CAPACITOR, Ceramic, 200 pF..... ±10%, 1000 V	1	
C14	201105-330	. CAPACITOR, Ceramic, 0.33 uF ..... ±10%, 50 V	1	
C15	201114-680	. CAPACITOR, Ceramic, 0.068 uF ..... ±10%, 50 V	1	
C16	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C17, C18	201215-100	. CAPACITOR, Ceramic, 100 000 pF ..... ±10%, 50 V	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C19	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C20	201105-224	. CAPACITOR, Ceramic, 0.22 uF ..... ±10%, 50 V	1	
C21, C23-C25	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	4	
C26	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C27	201148-120	. CAPACITOR, Ceramic, 0.12 uF ..... ±5%, 50 V	1	
C28	201114-680	. CAPACITOR, Ceramic, 0.068 uF ..... ±10%, 50 V	1	
C29	201109-200	. CAPACITOR, Ceramic, 200 pF..... ±10%, 1000 V	1	
C30	201114-680	. CAPACITOR, Ceramic, 0.068 uF ..... ±10%, 50 V	1	
C31	201102-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 100 V	1	
C32	201215-100	. CAPACITOR, Ceramic, 100 000 pF ..... ±10%, 50 V	1	
C33, C34	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C35	201104-011	. CAPACITOR, Disk, 1000 pF ..... ±10%, 500 V	1	
C36	201114-105	. CAPACITOR, Ceramic, 0.01 uF ..... ±10%, 50 V	1	
C37, C38	201114-184	. CAPACITOR, Ceramic, 0.0018 uF ..... ±10%, 50 V	2	
C39	201215-100	. CAPACITOR, Ceramic, 100 000 uF ..... ±10%, 50 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C40, C41	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C42	201149-470	. CAPACITOR, Ceramic, 0.047 uF ..... ±5%, 50 V	1	
C43	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C44	201104-011	. CAPACITOR, Disk, 1 000 pF..... ±10%, 500 V	1	
C45-C48	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	4	
C49, C50	201161-220	. CAPACITOR, Tantalum, 2.2 uF ..... ±10%, 15 V	2	
C51	201214-393	. CAPACITOR, Ceramic, 0.39 uF ..... ±10%, 50 V	1	
C52, C53	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	2	
C54	201214-393	. CAPACITOR, Ceramic, 0.093 uF ..... ±10%, 50 V	1	
C55, C56	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C57	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C58	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C60	201103-820	. CAPACITOR, Ceramic, 8 200 pF ..... ±10%, 50 V	1	
C61	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C62	201104-820	. CAPACITOR, Ceramic, 82 000pF..... ±10%, 50 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C64	201103-820	. CAPACITOR, Ceramic, 8 200 pF ..... ±10%, 50 V	1	
C65	201121-270	. CAPACITOR, DM, 270 pF ..... ±5%, 300 V	1	
C66	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C67	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C68, C69	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	2	
C70	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C71	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C73	201103-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C74	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C76	201103-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C77	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C78	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C79	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C80	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C81	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C82	201214-393	. CAPACITOR, Ceramic, 0.039 uF ..... ±10%, 50 V	1	
C83	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C84	201214-393	. CAPACITOR, Ceramic, 0.068 uF ..... ±10%, 50 V	1	
C85	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C86	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C87	201214-393	. CAPACITOR, Ceramic, 0.039 uF ..... ±10%, 50 V	1	
C88	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C89	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C90, C91	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C92	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C93	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C95	201103-820	. CAPACITOR, Ceramic, 8 200 pF ..... ±10%, 50 V	1	
C96	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C97	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C99	201103-820	. CAPACITOR, Ceramic, 8 200 pF ..... ±10%, 50 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C100	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C101	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C102	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C103	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C104	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C105	201214-393	. CAPACITOR, Ceramic, 0.039 uF ..... ±10%, 50 V	1	
C106	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C107	201214-393	. CAPACITOR, Ceramic, 0.039 uF ..... ±10%, 50 V	1	
C108	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C109	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C110	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C112	201103-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C113	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C114	201104-820	. CAPACITOR, Ceramic, 82 000 uF ..... ±10%, 50 V	1	
C115	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C116	201108-470	. CAPACITOR, Ceramic, 47 pF ..... ±5%, 600 V	1	
C117	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C119	201103-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C120	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	
C121	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C122	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C123	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C124, C125	201214-393	. CAPACITOR, Ceramic, 0.039 uF ..... ±10%, 50 V	2	
C126	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C127	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C128	201108-470	. CAPACITOR, Ceramic, 47 pF..... ±5%, 600 V	1	
C129	201108-033	. CAPACITOR, Ceramic, 3.3 pF ..... ±5%, 600 V	1	
C130	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C133	201103-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C134	201121-270	. CAPACITOR, DM, 27 pF ..... ±5%, 300 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C135, C136	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C137	201161-220	. CAPACITOR, Tantalum, 2.2 uF ..... ±10%, 15 V	1	
C138-C142	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	5	
C143, C144	201106-107	. CAPACITOR, Ceramic, 0.01 uF ..... ±10%, 50 V	2	
C145, C146	201105-111	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C147	201105-111	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C148-C151	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	4	
C152, C153	201104-011	. CAPACITOR, Disk, 1 000 pF..... ±10%, 500 V	2	
C154	201114-224	. CAPACITOR, Ceramic, 0.0022 uF ..... ±10%, 50 V	1	
C155, C156	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C157, C158	201102-020	. CAPACITOR, Ceramic, 220 pF..... ±10%, 50 V	2	
C159	201114-224	.CAPACITOR, Ceramic, 0.0022 uF ..... ±10%, 50 V	1	
C160	201104-011	. CAPACITOR, Disk, 1 000 pF..... ±10%, 50 V	1	
C161	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C162	201244-104	. CAPACITOR, Ceramic, 0.1 uF ..... ±20%, 50 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C163	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C164	201244-104	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 50 V	1	
C165	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C167-C171	201244-104	. CAPACITOR, Ceramic, 1.1 uF ..... ±20%, 50 V	5	
C172	201108-015	. CAPACITOR, Ceramic, 0.0015 uF ..... ±10%, 600 V	1	
C173	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C174-C181	201171-100	. CAPACITOR, Electrolytic, 10 uF..... 50 V	8	
C182	201149-100	. CAPACITOR, PC, 0.01 uF ..... ±5%, 50 V	1	
C183-C185	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	3	
C186	201105-111	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C187	201171-100	. CAPACITOR, electrolytic, 10 uF..... 50 V	1	
C188	201108-015	. CAPACITOR, Ceramic, 0.0015 uF ..... ±10%, 600 V	1	
C189-C191	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	2	
C192	201149-470	. CAPACITOR, PC, 0.047 uF ..... ±5%, 50 V	1	
C193	201244-104	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 50 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C194	970085-001	. CAPACITOR, DM, 680 pF ..... ±1%, 300 V	1	
C195	201103-470	. CAPACITOR, Ceramic, 4 700 pF ..... ±10%, 50 V	1	
C196	201244-104	. CAPACITOR, Ceramic, 0.1 uF ..... ±20%, 50 V	1	
C197	201100-500	. CAPACITOR, Ceramic, 5 pF..... ±5%, 600 V	1	
C198-C200	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	3	
C201	201116-330	. CAPACITOR, Ceramic, 3 300 pF ..... ±20%, 100 V	1	
C202, C203	201244-104	. CAPACITOR, Ceramic, 0.1 uF ..... ±20%, 50 V	2	
C204	201191-006	. CAPACITOR, Aluminum, epoxy end seal	1	
C205	201116-330	. CAPACITOR, Ceramic, 3 300 pF ..... ±20%, 100 V	1	
C206	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C207	201114-105	. CAPACITOR, Ceramic, 0.01 uF ..... ±10%, 50 V	1	
C208	201108-100	. CAPACITOR, Ceramic, 100 pF..... ±5%, 600 V	1	
C209	201112-150	. CAPACITOR, Ceramic, 150 pF..... ±10%, 100 V	1	
C210-C220	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C222	970260-001	. CAPACITOR, Ceramic, 0.01 uF ..... ±20%, 16 V	1	
C223	201102-330	. CAPACITOR, Ceramic, 330 pF..... ±10%, 500 V	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
C224	201102-330	. CAPACITOR, Ceramic, 330 pF..... ±10%, 500 V	1	
C225	201104-011	. CAPACITOR, Disk, 1 000 pF..... ±10%, 500 V	1	
C226	201112-180	. CAPACITOR, Ceramic, 180 pF..... ±10%, 50 V	1	
C227	201191-006	. CAPACITOR, Aluminum, epoxy end seal	1	
C228	201104-820	. CAPACITOR, Ceramic, 82 000 pF ..... ±10%, 50 V	1	
C229-C235	201215-100	. CAPACITOR, Ceramic, 100 000 pF ..... ±10%, 50 V	7	
C236	970205-001	. CAPACITOR, Ceramic, 0.1 uF ..... ±10%, 100 V	1	
C237	970478-001	. CAPACITOR, Hylar, 0.1 uF..... ±20%, 63 V	1	
C238	970205-001	. CAPACITOR, Ceramic, 0.1 uF ..... ±10%, 100 V	1	
C239	970478-001	. CAPACITOR, Hylar, 0.1 uF..... ±20%, 63 V	1	
C240	970205-001	. CAPACITOR, Ceramic, 0.1 uF ..... ±10%, 100 V	1	
C241	970478-001	. CAPACITOR, Hylar, 0.1 uF..... ±20%, 63 V	1	
C242, C243	201161-220	. CAPACITOR, Tantalum, 22 uF..... ±10%, 15 V	2	
CR1-CR8	202018-999	. DIODE, Switching	6	
CR9	202009-999	. DIODE, Rectifier, 1 amp	1	
CR10	202013-226	. DIODE, Zener, ±5%, 3.6 V	1	
CR11-CR13	202018-999	. DIODE, Switching	3	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
CR14, CR15	202034-999	. DIODE, Rectifier	2	
CR16, CR17	202009-999	. DIODE, Rectifier, 1 amp	2	
CR18-CR23	202018-999	. DIODE, Switching	6	
DS1	202006-100	. DIODE, Light Emitting.....	1	
J1	211011-008	. SOCKET, 8 pin, Low Profile	1	
K1	210197-200	. RELAY, 2 PDT, 10 amp, 24 V	1	
L1	209991-004	. INDUCTOR, 0.47 mHy	1	
Q1	960082-001	. TRANSISTOR, NPN, Darlington	1	
Q2	960081-001	. TRANSISTOR, PNP, Darlington	1	
Q3	960082-001	. TRANSISTOR, NPN, Darlington	1	
Q4	960081-001	. TRANSISTOR, PNP, Darlington	1	
Q5	204026-057	. TRANSISTOR, NPN, Darlington	1	
Q6	204026-050	. TRANSISTOR PNP, Darlington.....	1	
Q8	204010-700	. TRANSISTOR, PNP, Power	1	
Q9	204010-533	. TRANSISTOR, NPN, Silicon	1	
Q10	204007-700	. TRANSISTOR, NPN, Silicon	1	
Q11	204010-535	. TRANSISTOR, NPN, Silicon	1	
Q12	204010-700	. TRANSISTOR, PNP, Power	1	
Q13	204010-533	. TRANSISTOR, NPN, Silicon	1	
Q14	204007-700	. TRANSISTOR, NPN, Power.....	1	
Q15	204010-535	. TRANSISTOR, PNP, Silicon.....	1	
Q16	204012-999	. TRANSISTOR, PNP, Silicon.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
Q17	204027-037	. TRANSISTOR, NPN, Silicon	1	
Q18	204012-999	. TRANSISTOR, PNP, Silicon.....	1	
Q20	203013-317	. INTEGRATED CIRCUIT, Regulator, +5 V ±5%....	1	
Q21	204010-533	. TRANSISTOR, NPN, Silicon	1	
Q22	204010-535	. TRANSISTOR, PNP, Silicon.....	1	
Q23	204010-533	. TRANSISTOR, NPN, Silicon	1	
Q24	204013-999	. TRANSISTOR, NPN, Silicon	1	
Q25	204012-999	. TRANSISTOR, PNP, Silicon.....	1	
Q26-Q34	204013-999	. TRANSISTOR, NPN, Silicon	9	
Q35	204012-999	. TRANSISTOR, PNP, Silicon.....	1	
Q36	204027-034	. TRANSISTOR, PNP, Silicon.....	1	
Q37	204012-999	. TRANSISTOR, PNP, Silicon.....	1	
Q38	204027-034	. TRANSISTOR, PNP, Silicon.....	1	
Q39	204027-037	. TRANSISTOR, NPN, Silicon	1	
Q40	204027-037	. TRANSISTOR, NPN, Silicon	1	
R3	200075-180	. RESISTOR, FC, 180.00 Ohm, 1/4 W, ±5%	1	
R4, R5	200073-470	. RESISTOR, FC, 4.70 Ohm, 1/4 W, ±5%	1	
R6	200071-470	. RESISTOR, FC, 47 Ohm, 1/4 W, ±5%.....	1	
R7	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	1	
R8	200073-750	. RESISTOR, FC, 7.50 K Ohm, 1/4 W, ±5%	1	
R9	200073-200	. RESISTOR, FC, 2 K Ohm, 1/4 W, ±5%.....	1	
R10	200071-470	. RESISTOR, FC, 47 Ohm, 1/4 W, ±5%.....	1	
R11	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R12	200073-750	. RESISTOR, FC, 7.50 K Ohm, 1/4 W, ±5%	1	
R13, R14	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	2	
R15, R16	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	2	
R17	200075-180	. RESISTOR, FC, 180.00 K Ohm, 1/4 W, ±5%	1	
R18	200013-475	. RESISTOR, FF, 4.75 K Ohm, 1/8 W, ±1%	1	
R19	200013-392	. RESISTOR, FF, 3.92 K Ohm, 1/8 W, ±1%	1	
R20, R21	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	2	
R22	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R23, R24	200013-392	. RESISTOR, FF, 3.92 K Ohm, 1/8 W, ±1%	2	
R25	200014-121	. RESISTOR, FF, 12.1 K Ohm, 1/8 W, ±1%	1	
R26	200076-470	. RESISTOR, FC, 4.70 meg Ohm, 1/4 W, ±5%.....	1	
R27-R30	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	4	
R31	200071-470	. RESISTOR, FC, 47 Ohm, 1/4 W, ±5%.....	1	
R32	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	1	
R33	200073-750	. RESISTOR, FC, 7.50 K Ohm, 1/4 W, ±5%	1	
R34	200073-200	. RESISTOR, FC, 2 K Ohm, 1/4 W, ±5%.....	1	
R35	200071-470	. RESISTOR, FC, 47 Ohm, 1/4 W, ±5%.....	1	
R36	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	1	
R37	200073-750	. RESISTOR, FC, 7.50 K Ohm, 1/4 W, ±5%	1	
R38	200509-100	. RESISTOR, WW, 0.1 Ohm, 3 W, ±1%	1	
R39	200509-100	. RESISTOR, WW, 0.1 Ohm, 3 W, ±1%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R40, R41	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W, ±1%	2	
R42, R43	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	2	
R44	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R45	200013-475	. RESISTOR, FF, 4.75 K Ohm, 1/8 W, ±1%	1	
R46	200072-330	. RESISTOR, FC, 330 Ohm, 1/4 W, ±5%.....	1	
R47	200013-475	. RESISTOR, FF, 4.75 K Ohm, 1/8 W, ±1%	1	
R48	200013-392	. RESISTOR, FF, 3.92 K Ohm, 1/8 W, ±1%	1	
R49	200013-866	. RESISTOR, FF, 8.66 K Ohm, 1/8 W, ±1%	1	
R50	200014-221	. RESISTOR, FF, 22.1 K Ohm, 1/8 W, ±1%	1	
R51	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R52	200074-510	. RESISTOR, FC, 51.00 K Ohm, 1/4 W, ±5%	1	
R53	200015-499	. RESISTOR, FF, 499 K Ohm, 1/8 W, ±1%.....	1	
R54	200015-332	. RESISTOR, FF, 332 K Ohm, 1/8 W, ±1%.....	1	
R55	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W, ±1%.....	1	
R56	200075-750	. RESISTOR, FC, 750.00 K Ohm, 1/4 W, ±5%	1	
R57	200014-806	. RESISTOR, FF, 80.6 K Ohm, 1/8 W, ±1%	1	
R58	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W, ±1%.....	1	
R59-R61	200014-100	. RESISTOR, FF, 10.0 K Ohm, 1/8 W, ±1%	3	
R62, R63	200013-100	. RESISTOR, FF, 1.00 K Ohm, 1/8 W, ±1%	2	
R64	200014-100	. RESISTOR, FF, 10.0 K Ohm, 1/8 W, ±1%	1	
R65	200074-620	. RESISTOR, FC, 62.00 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R66, R67	200014-100	. RESISTOR, FF, 10.00 K Ohm, 1/8 W, ±1%	2	
R68	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R69	200014-221	. RESISTOR, FF, 22.1 K Ohm, 1/8 W, ±1%	1	
R70	200013-475	. RESISTOR, FF, 4.75 K Ohm, 1/8 W, ±1%	1	
R71, R72	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	2	
R73	200013-432	. RESISTOR, FF, 4.32 K Ohm, 1/8 W, ±1%	1	
R74	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R75	200014-221	. RESISTOR, FF, 22.1 K Ohm, 1/8 W, ±1%	1	
R76	200076-470	. RESISTOR, FC, 4.70 meg, Ohm, 1/4 W, ±5%	1	
R77	200075-750	. RESISTOR, FC, 750.00 K Ohm, 1/4 W, ±5%	1	
R78	200014-402	. RESISTOR, FF, 40.2 K Ohm, 1/8 W, ±1%	1	
R79	200015-100	. RESISTOR, FF, 100 K Ohm, 1/8 W, ±1%.....	1	
R80	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R82	200013-301	. RESISTOR, FF, 3.01 K Ohm, 1/8 W, ±1%	1	
R83	200013-392	. RESISTOR, FF, 3.92 K Ohm, 1/8 W, ±1%	1	
R84, R85	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	2	
R86, R87	200073-150	. RESISTOR, FC, 1.50 K Ohm, 1/4 W, ±5%	1	
R88, R89	200071-100	. RESISTOR, FC, 10 Ohm, 1/4 W, ±5%.....	2	
R90	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W, ±5%.....	1	
R92-R95	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	4	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R96	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R97	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R98, R99	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	2	
R100	200074-100	. RESISTOR, FC, 10 K Ohm, 1/4 W, ±5%.....	1	
R103	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	1	
R104-R111	200075-220	. RESISTOR, FC, 220.00 K Ohm, 1/4 W, ±5%	8	
R112	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R113	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W, ±5%	1	
R114	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R115	200209-202	. POTENTIOMETER, Ceramic, 2 K Ohm, ... 1/4 W, ±5%	1	
R116-R123	200073-470	. RESISTOR, FC, 4.70 Ohm, 1/4 W, ±5%	8	
R124	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R125-R131	200073-470	. RESISTOR, FC, 4.70 Ohm, 1/4 W, ±5%	7	
R131	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	2	
R132, R133	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	2	
R134	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R135	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R136	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R137	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R138	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R139	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R140	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R141	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R142	200071-680	. RESISTOR, FC, 68 K Ohm, 1/4 W, ±5%.....	1	
R142-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R143	200071-330	. RESISTOR, FC, 33 K Ohm, 1/4 W, ±5%.....	1	
R144	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R145	200071-680	. RESISTOR, FC, 68 K Ohm, 1/4 W, ±5%.....	1	
R145-1	200063-750	. RESISTOR, FC, 7.50 K Ohm, 1/8 W, ±5%	1	
R146	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R147	200071-330	. RESISTOR, FC, 33 K Ohm, 1/4 W, ±5%.....	1	
R148	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R149	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R150	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R151	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R152	200073-330	. RESISTOR, FC, 3.30 Ohm, 1/4 W, ±5%	1	
R153	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R154	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R155	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R156	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R157	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R158	200073-470	. RESISTOR, FC, 4.7 K Ohm, 1/4 W, ±5%	1	
R159	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R160	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R161	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R162	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R163	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R164	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R164-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R165	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R166	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R167	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R167-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R168	200071-330	. RESISTOR, 33 Ohm, 1/4 W, ±5%	1	
R169	200073-330	. RESISTOR, FC, 3.3 K Ohm, 1/4 W, ±5%	1	
R170	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R171	200073-330	. RESISTOR, FC, 3.3 K Ohm, 1/4 W, ±5%	1	
R172	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R173	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R174	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R175	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R176	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R177	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R178	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R179	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 , ±5%.....	1	
R180	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R181	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R182	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R183	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R184	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R185	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R186	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R186-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R187	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R188	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R189	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R190	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R191	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R192	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R193	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R194	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R195	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R196	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R197	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R197-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R198	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R199	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R200	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R201	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R202	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R203	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R204	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R205	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R206	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R207	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R208	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R208-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R209	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R210	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R211	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R212	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R213	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R214	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R215	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R216	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R217	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R218	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R219	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R219-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R220	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R221	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R222	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R223	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R224	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R225	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R226	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R227	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R228	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R229	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R230	200071-680	. RESISTOR, FC, 68 Ohm, 1/4 W, ±5%.....	1	
R230-1	200063-750	. RESISTOR, FC, 7.5 K Ohm, 1/8 W, ±5%	1	
R231	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R232	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R233	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	1	
R234, R235	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	1	
R236, R237	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	2	
R238	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	2	
R240, R241	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	2	
R242	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	1	
R243	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	1	
R244	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	1	
R245	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	1	
R246	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R247, R248	200082-390	. RESISTOR, FC, 390 Ohm, 1/2 W, ±5%.....	2	
R249	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W, ±5%.....	1	
R250	200082-360	. RESISTOR, FC, 360 Ohm, 1/2 W,.....	1	
R251	200071-330	. RESISTOR, FC, 33 Ohm, 1/4 W, ±5%.....	1	
R252	200072-240	. RESISTOR, FC, 240 Ohm, 1/4 W, ±5%.....	1	
R253	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R254	200073-330	. RESISTOR, FC, 3.30 K Ohm, 1/4 W, ±5%	1	
R255	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R256	200073-150	. RESISTOR, FC, 1.50 K Ohm, 1/4 W, ±5%	1	
R257	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W, ±5%	1	
R258	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R259-R262	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	4	
R263	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W, ±5%	1	
R264	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	
R265	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W, ±5%	1	
R266	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	
R267	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W, ±5%	1	
R268	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	
R269	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W, ±5%	1	
R270	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	
R271	200073-120	. RESISTOR, FC, 1.20 K Ohm, 1/4 W, ±5%	1	
R272	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R273	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	1	
R275	200071-150	. RESISTOR, FC, 15 Ohm, 1/4 W, ±5%.....	1	
R276	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R277	200071-150	. RESISTOR, FC, 15 Ohm, 1/4 W, ±5%.....	1	
R278	200013-976	. RESISTOR, FC, 9.76 K Ohm, 1/8 W, ±1%	1	
R279	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R280	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R281	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R282	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	1	
R283	200076-470	. RESISTOR, FC, 4.70 meg Ohm, 1/4 W, ±5%.....	1	
R284	200016-100	. RESISTOR, FC, 1.00 meg Ohm, 1/8 W, ±1%.....	1	
R285	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R285	200076-270	. RESISTOR, FC, 2.70 meg Ohm, 1/4 W, ±5%.....	1	
R286	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R287	200073-130	. RESISTOR, FC, 1.30 K Ohm, 1/4 W, ±5%	1	
R288-R291	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	4	
R292	200073-130	. RESISTOR, FC, 1.30 K Ohm, 1/4 W, ±5%	1	
R293	200074-120	. RESISTOR, FC, 12.00 K Ohm, 1/4 W, ±5%	1	
R294	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W, ±5%.....	1	
R295	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	1	
R296	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W, ±5%.....	1	
R297	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R298	200070-560	. RESISTOR, FC, 5.60 Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R299	200072-100	. RESISTOR, FC, 100 Ohm, 1/4 W, ±5%.....	1	
R300	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W, ±5%.....	1	
R301	200072-430	. RESISTOR, FC, 430 Ohm, 1/4 W, ±5%.....	1	
R302	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R304	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R305	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	1	
R306	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W, ±5%.....	1	
R307, R308	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	2	
R309	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R310	200074-130	. RESISTOR, FC, 13.00 K Ohm, 1/4 W, ±5%	1	
R311	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W, ±5%	1	
R312	200074-330	. RESISTOR, FC, 33.00 K Ohm, 1/4 W, ±5%	1	
R313	200073-180	. RESISTOR, FC, 1.80 K Ohm, 1/4 W, ±5%	1	
R313-3,4	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	2	
R314	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W, ±5%	1	
R315	200074-470	. RESISTOR, FC, 47.00 K Ohm, 1/4 W, ±5%	1	
R316	200076-510	. RESISTOR, FC, 5.1 meg Ohm, 1/4 W, ±5%.....	1	
R317	200073-430	. RESISTOR, FC, 4.30 K Ohm, 1/4 W, ±5%	1	
R318	200072-200	. RESISTOR, FC, 200 Ohm, 1/4 W, ±5%.....	1	
R319, R320	200075-220	. RESISTOR, FC, 220.00 K Ohm, 1/4 W, ±5%	2	
R321	200073-200	. RESISTOR, FC, 2 K Ohm, 1/4 W, ±5%.....	1	
R322	200013-249	. RESISTOR, FF, 2.49 K Ohm, 1/8 W, ±1%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R323	200093-150	. RESISTOR, FC, 1.5 K Ohm, 1 W, ±5%	1	
R324	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R325	200093-150	. RESISTOR, FC, 1.5 K Ohm, 1 W, ±5%	1	
R326	200072-270	. RESISTOR, FC, 270 Ohm, 1/4 W, ±5%	1	
R327	200072-330	. RESISTOR, FC, 330 Ohm, 1/4 W, ±5%	1	
R329	200072-270	. RESISTOR, FC, 270 Ohm, 1/4 W, ±5%	1	
R330	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	1	
R330-R332	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	3	
R333	200013-261	. RESISTOR, FF, 2.61 K Ohm, 1/8 W, ±1%	1	
R334	200073-620	. RESISTOR, FC, 6.20 K Ohm, 1/4 W, ±5%	1	
R335	200013-604	. RESISTOR, FF, 6.04 K Ohm, 1/8 W, ±1%	1	
R336	200074-510	. RESISTOR, FC, 51.00 K Ohm, 1/4 W, ±5%	1	
R337-R340	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	4	
R341	200075-100	. RESISTOR, FC, 100.00 K Ohm, 1/4 W, ±5%	1	
R342	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R343	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R344	200014-100	. RESISTOR, FF, 10.0 K Ohm, 1/8 W, ±1%	1	
R346, R347	200072-680	. RESISTOR, FC, 680 Ohm, 1/4 W, ±5%	2	
R348	200074-150	. RESISTOR, FC, 15.00 K Ohm, 1/4 W, ±5%	1	
R349	200074-510	. RESISTOR, FC, 51.00 K Ohm, 1/4 W, ±5%	1	
R350	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W, ±5%	1	
R351	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
R352	200073-110	. RESISTOR, FC, 1.10 K Ohm, 1/4 W, ±5%	1	
R353-R355	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	3	
R356	200073-150	. RESISTOR, FC, 1.50 K Ohm, 1/4 W, ±5%	1	
R357	200074-200	. RESISTOR, FC, 20.00 K Ohm, 1/4 W, ±5%	1	
R358	200071-100	. RESISTOR, FC, 10 Ohm, 1/4 W, ±5%.....	1	
R359	200073-100	. RESISTOR, FC, 1.00 K Ohm, 1/4 W, ±5%	1	
R360	200073-240	. RESISTOR, FC, 2.40 K Ohm, 1/4 W, ±5%	1	
R361, R362	200072-470	. RESISTOR, FC, 470 Ohm, 1/4 W, ±5%.....	2	
R363-R367	200074-100	. RESISTOR, FC, 10.00 K Ohm, 1/4 W, ±5%	4	
R368	200073-220	. RESISTOR, FC, 2.20 K Ohm, 1/4 W, ±5%	1	
R369	200074-220	. RESISTOR, FC, 22.00 K Ohm, 1/4 W, ±5%	1	
R370, R371	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W, ±5%.....	2	
R372	200073-470	. RESISTOR, FC, 4.70 K Ohm, 1/4 W, ±5%	1	
R373	200014-100	. RESISTOR, FF, 10.0 K Ohm, 1/8 W, ±1%	1	
R374	200071-820	. RESISTOR, FC, 82 Ohm, 1/4 W, ±5%.....	1	
R375	200072-150	. RESISTOR, FC, 150 Ohm, 1/4 W, ±5%.....	1	
R376	200072-220	. RESISTOR, FC, 220 Ohm, 1/4 W, ±5%.....	1	
TPO-97	205026-299	. TEST POINT, .058 diameter pin	98	
U1H	203039-001	. INTEGRATED CIRCUIT, Dual-D, flip-flop.....	1	
U1J	970221-001	. INTEGRATED CIRCUIT, Quad 2-input, ... positive NAND gate	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U1K	203007-700	. INTEGRATED CIRCUIT, Voltage comparator	1	
U2G	203031-050	. INTEGRATED CIRCUIT, Dual, 4-input ..... positive NAND gate	1	
U2H	203094-501	. INTEGRATED CIRCUIT, Dual J-K, ... positive edge trigger	1	
U2J	203029-003	. INTEGRATED CIRCUIT, Triple, 3-input, ... NAND gate	1	
U2K	203046-001	. INTEGRATED CIRCUIT, Retriggerable, ... MNST, MLTV	1	
U2M	203009-005	. INTEGRATED CIRCUIT, Operational ..... amplifier, bifet	1	
U2N, U2R	203052-051	. INTEGRATED CIRCUIT, Multiplexer, ... 8 channel	2	
U2V	970221-001	. INTEGRATED CIRCUIT, Quad, 2-input, ... NAND gate	1	
U2W	203046-148	. INTEGRATED CIRCUIT, 3-8 Line decoder.....	1	
U3A	203012-136	. INTEGRATED CIRCUIT, Quad ..... operational amplifier	1	
U3B	203052-053	. INTEGRATED CIRCUIT, Multiplexer, ... 2-channel	1	
U3D, U3E	203012-136	. INTEGRATED CIRCUIT, Quad ..... operational amplifier	2	
U3G	203071-999	. INTEGRATED CIRCUIT, Dual V cont, MLTV.....	1	
U3H	203048-150	. INTEGRATED CIRCUIT, Synchronous, ... 4-bit counter	1	
U3J	970011-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U3K	203036-038	. INTEGRATED CIRCUIT, Quad, 2-input, ... positive NAND buffer	1	
U3L	203081-001	. INTEGRATED CIRCUIT, Quad, 2-input ..... positive NOR gate	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U3M	203009-005	. INTEGRATED CIRCUIT, Operational ..... amplifier, bifet	1	
U3N	203049-008	. INTEGRATED CIRCUIT, Dia conv, 8 bit,..... high speed	1	
U3V	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U3W	205255-500	. RESISTOR NETWORK 220/330 Ohm	1	
U4B	203052-053	. INTEGRATED CIRCUIT, Multiplexer 2-channel	1	
U4N	203046-001	. INTEGRATED CIRCUIT, Rtrig MNST MLTV	1	
U4P	970010-001	. INTEGRATED CIRCUIT, Quad, 2-input ..... positive NAND gate	1	
U4R	203036-038	. INTEGRATED CIRCUIT, Quad, 2-input ..... positive NAND buffer	1	
U4V	970010-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U4W	970011-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U5E	203012-136	. INTEGRATED CIRCUIT, Quad..... Operational Amplifier	1	
U5F	203029-010	. INTEGRATED CIRCUIT, 3-input	1	
U5G	203012-999	. INTEGRATED CIRCUIT, Phase ..... frequency detector	1	
U5H	203094-501	. INTEGRATED CIRCUIT, Dual, J-K..... positive edge trigger	1	
U5V	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U5W	970011-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U6A, U6B	203094-501	. INTEGRATED CIRCUIT, Dual J-K,..... positive edge trigger	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U6F, U6G	203051-174	. INTEGRATED CIRCUIT, Hex D-type flip flop	2	
U6H	203007-700	. INTEGRATED CIRCUIT, Voltage comparator	1	
U6L	203575-101	. INTEGRATED CIRCUIT, Microprocessor, MOS	1	
U6N	961634-001	. SOFTWARE ASSY	1	A
	961614-001	. SOFTWARE ASSY	1	B
U6P	203565-102	. INTEGRATED CIRCUIT, Memory, MOS RAM 256 X 2	1	
U6V	203029-003	. INTEGRATED CIRCUIT, 3-input AND gate	1	
U6W	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate	1	
U7A, U7B	203094-501	. INTEGRATED CIRCUIT, Dual J-K, positive edge trigger	2	
U7C	203046-151	. INTEGRATED CIRCUIT, 1-8 data select MUXR	1	
U7D	203048-150	. INTEGRATED CIRCUIT, Synchronous 4-bit counter	1	
U7E	203046-153	. INTEGRATED CIRCUIT, 4-1 line select MLTP	1	
U7F	203049-164	. INTEGRATED CIRCUIT, 8-bit parallel output	1	
U7G	160102-445	. SOFTWARE ASSY, PE Controller	1	
U7H	970011-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U7P	203565-102	. INTEGRATED CIRCUIT, Memory, MOS RAM 256 X 2	1	
U7V	203051-174	. INTEGRATED CIRCUIT, Hex D-type flip flop	1	
U7W	203036-038	. INTEGRATED CIRCUIT, Quad, 2-input, positive NAND buffer	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U8A-U8C	970011-001	. INTEGRATED CIRCUIT, Hex inverter	3	
U8D	203046-148	. INTEGRATED CIRCUIT, 3-8 line decoder	1	
U8E, U8F	203049-164	. INTEGRATED CIRCUIT, 8-bit ..... parallel output	2	
U8L	203001-881	. INTEGRATED CIRCUIT, Parallel I/O	1	
U8N	961634-002	. SOFTWARE ASSY, ...	1	A
	961614-002	. SOFTWARE ASSY.....	1	B
U8P	203042-510	. INTEGRATED CIRCUIT, Counter/Latch,..... binary	1	
U8R	970452-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U8V	203036-038	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND buffer	1	
U8W	211015-003	. SWITCH DIP, 8 position sealed.....	1	
U9A-U9D	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	4	
U9E	203047-157	. INTEGRATED CIRCUIT, Quad 2-to-1 ..... line data	1	
U9F	203049-164	. INTEGRATED CIRCUIT, 8-bit parallel..... output	1	
U9G	160101-447	. SOFTWARE ASSY, Read deskew	1	
U9P	203046-156	. INTEGRATED CIRCUIT, Dual 2-to-4 ..... line decoder	1	
U9R	203039-001	. INTEGRATED CIRCUIT, Dual D flip flop.....	1	
U9V	203036-038	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND buffer	1	
U9W	203061-280	. INTEGRATED CIRCUIT, Parity tree, ... 9 input	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U10B, U10C	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	2	
U10D,	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	2	
U10F	203046-151	. INTEGRATED CIRCUIT, 1-to-8 Data ..... select MUXR	2	
U10H	203082-500	. INTEGRATED CIRCUIT, Hex buffer/drivers	1	
U10L	203001-881	. INTEGRATED CIRCUIT, Parallel I/O	1	
U10N	961634-003	. SOFTWARE ASSY, ...	1	A
	961614-003	. SOFTWARE ASSY.....	1	B
U10P	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U10R	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U10V	970010-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U10W	205255-500	. RESISTOR NETWORK, 220/330 Ohm	1	
U11B, U11C	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	2	
U11D	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U11E, U11F	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	2	
U11P,	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	2	
U11V	203035-032	. INTEGRATED CIRCUIT, QUAD 2 input ..... positive OR gate	1	
U11W	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U12B-U12D	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	3	
U12E	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U12F	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U12G	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U12H	160101-461	. SOFTWARE ASSY, Data drop.....	1	
U12L	203001-881	. INTEGRATED CIRCUIT, Parallel I/O	1	
U12P	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U12R, U12V	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	2	
U12W	203051-100	. INTEGRATED CIRCUIT, Quad D-type ..... flip flop	1	
U13A	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	1	
U13B, U13C	203094-501	. INTEGRATED CIRCUIT, Dual J-K ..... positive edge trigger	2	
U13D	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	1	
U13E,	203094-501	. INTEGRATED CIRCUIT, Dual J-K ..... positive edge trigger	2	
U13G	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	1	
U13H, U13V	203094-501	. INTEGRATED CIRCUIT, Dual J-K ..... positive edge trigger	2	
U13W	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U14B	203085-001	. INTEGRATED CIRCUIT, SCHM trig ..... input, hex IV	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U14C	203007-350	. INTEGRATED CIRCUIT, Voltage..... comparator buffer	1	
U14D	203085-001	. INTEGRATED CIRCUIT, SCHM, ... trig input, hex IV	1	
U14F	203007-350	. INTEGRATED CIRCUIT, Voltage..... comparator buffer	1	
U14G	203085-001	. INTEGRATED CIRCUIT, SCHM, ... trig input, hex IV	1	
U14H	203007-350	. INTEGRATED CIRCUIT, Voltage..... comparator buffer	1	
U14L	203001-881	. INTEGRATED CIRCUIT, Parallel I/O	1	
U14N	203555-101	. INTEGRATED CIRCUIT, Control, MOS	1	
U14N	211011-028	. SOCKET, 28 Pin, low profile.....	1	
U14R	160101-448	. SOFTWARE ASSY, data write	1	
U14V	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U14W	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U15A- U15H	203007-350	. INTEGRATED CIRCUIT, Voltage..... comparator buffer	6	
U15V	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	1	
U15W	203042-001	. INTEGRATED CIRCUIT, Quad XOR gate.....	1	
U17A- U17I	203130-999	. INTEGRATED CIRCUIT, JFET, input OP amp.....	9	
U17J	203026-500	. INTEGRATED CIRCUIT, Hex inverter,..... bfr/drvr	1	
U17K	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	1	
U17L	203122-368	. INTEGRATED CIRCUIT, Hex bus driver.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U17M	203029-002	. INTEGRATED CIRCUIT, 3-input ..... positive NAND gate	1	
U17N	203081-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NOR gate	1	
U17P	203048-150	. INTEGRATED CIRCUIT, Sync 4-bit counter	1	
U17R	203039-001	. INTEGRATED CIRCUIT, Dual-D flip-flop	1	
U17T	970011-001	. INTEGRATED CIRCUIT, Hex inverter	1	
U17V	203036-038	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND buffer	1	
U17W	203102-002	. INTEGRATED CIRCUIT, Dual,..... multivibrator	1	
U17X	203036-038	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND buffer	1	
U18J, U18K	203082-500	. INTEGRATED CIRCUIT, Hex buffer/driver.....	2	
U18L	203051-100	. INTEGRATED CIRCUIT, Quad D-type ..... flip flop	1	
U18M	203039-001	. INTEGRATED CIRCUIT, Dual-D flip flop	1	
U18N	203048-205	. INTEGRATED CIRCUIT, UP/DN ..... Synchronous counter	1	
U18P, U18R	203048-150	. INTEGRATED CIRCUIT, Synchronous..... 4-bit counter	2	
U18T	970221-001	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND gate	1	
U18V, U18W	203051-100	. INTEGRATED CIRCUIT, Quad D-type ..... flip flop	2	
U18X	203036-038	. INTEGRATED CIRCUIT, Quad, 2-input ..... positive NAND buffer	1	
U19A-U19I	203043-500	. INTEGRATED CIRCUIT, Operational amp, ... high performance	9	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
U19T	203007-700	. INTEGRATED CIRCUIT, Voltage comparator	1	
U19V	203049-164	. INTEGRATED CIRCUIT, 8-bit parallel ..... output	1	
U19W U19X	203051-174	. INTEGRATED CIRCUIT, Hex D-type ..... flip flop	2	
U20N	203012-136	. INTEGRATED CIRCUIT, Quad ..... operational amplifier	1	
U20X	203036-038	. INTEGRATED CIRCUIT, Quad 2-input ..... positive NAND buffer	1	
VR1	203013-300	. INTEGRATED CIRCUIT, Voltage regulator	1	
VR2	203013-210	. INTEGRATED CIRCUIT, Voltage regulator	1	
W1 W15, W16, W19	208500-605	. WIRE, Jumper, insulated	4	
XK1	211078-999	. SOCKET, Relay.....	1	
XU3W	211011-016	. SOCKET, 16 Pin, low profile.....	1	
X76L	211011-040	. SOCKET, 40 Pin, low profile.....	1	
XU6N	211011-024	. SOCKET, 24 Pin, low profile.....	1	
XU6P	211011-018	. SOCKET, 18 Pin, low profile.....	1	
XU7G	211011-016	. SOCKET, 16 Pin, low profile.....	1	
XU7P	211011-018	. SOCKET, 18 Pin, low profile.....	1	
XU8L	211011-040	. SOCKET, 40 Pin, low profile.....	1	
XU8N, XU9G	211011-024	. SOCKET, 24 Pin, low profile.....	2	
XU10L	211011-040	. SOCKET, 40 Pin, low profile.....	1	
XU10N	211011-024	. SOCKET, 24 Pin, low profile.....	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-12				
XU10W	211011-016	. SOCKET, 16 Pin, low profile.....	1	
XU12L	211011-040	. SOCKET, 40 Pin, low profile.....	1	
XU12N	211011-024	. SOCKET, 24 Pin, low profile.....	1	
XU14L	211011-040	. SOCKET, 40 Pin, low profile.....	1	
XU17K	205025-516	. SOCKET, 16 Pin, low profile.....	1	
Y1	210111-800	. CRYSTAL, Quartz, 8.000 megHz.....	1	

BLANK

SECTION VI

GLOSSARY OF TERMS

A0 -A15 — Address Bus - Tri-State output, active high. Provides the address for memory data exchanges and I/O device data exchanges.

A0 — A Phase - One of two clocks generated by the tachometer. These clocks are used to determine tape speed, direction, and position.

B/A SEL — PIO Port B or A Select (input, active high) - This pin defines which port will be accessed during a data transfer between the Z80-PIO. A low level on this pin selects Port A while a high level selects Port B.

BITCLK — Bit Clock - Used to generate PECLK when both channel two and channel one are dropped. (This condition will cause the Hard Error line to go active during data recovery.)

BLOCK — Block - Term identifying a data record. Block goes active approximately 15 character times into the preamble.

B0 — B Phase - One of two clocks generated by the tachometer. These clocks are used to determine tape speed, direction, and position.

CS1-CS0 — Channel Select for CTC (input, Active high) - These pins form a 2-bit binary address code for selecting one of the four independent CTC channels for an I/O Write or Read (See truth table below.)

	CS1	CS0
Ch0	0	0
Ch1	0	1
Ch2	1	0
Ch3	1	1

CE* — Chip Enable of CTC (input, Active low) - A low level on this pin enables the CTC to accept control words, Interrupt Vectors, or time constant data words from the Z80 Data Bus during an I/O Read cycle.

C/D Sel	Control or Data Select for PIO (input, active high) - This pin defines the type of data transfer to be performed between the CPU and the PIO. A high level on this pin during a CPU write to the PIO causes the Z80 data bus to be interpreted as a command for the port selected by the B/A Select line. A low level on this pin means that the Z80 data bus is being used to transfer data between the CPU and the PIO. Often Address bit A1 from the CPU will be used for this function.
CDATX	Corrected Data Multiplexed - Data byte that is sent to the output register in serial form.
CHDROP P, Ø -7	Channel Drop - This signal indicates the loss of a data channel for a minimum of 4 character times.
CLK8M	Eight MegaHertz Clock - This clock is used to generate Phase Clock (θ), One MegaHertz Clock (θ1M), RNOISE, and Write Clock (W2XCLK).
CTCCLKØ	CTC Clock Zero - This clock indicates that tape is in motion. Also indicates forward or reverse direction depending on the tachometer quadrature.
CTCCLK1	CTC Clock 1 - This clock indicates that tape is in motion. Also indicates forward or reverse direction depending on the tachometer quadrature.
CTCZC2	CTC Clock Two - This Clock output from the CTC of approximately 40Hz is used to generate a sawtooth waveform for the compliance arm transducer.
D0-D7	CTC Data Bus of CTC - Tri-state input/output, active high. D0-D7 constitutes an 8-bit bidirectional data bus. The data bus is used for data exchanges with memory and I/O devices.
DATA	Recovered Data - Refers to the nine data lines clocked into the formatter.
DATA P,Ø -7	Data - Refers to the data lines from the read logic to the formatter.
DAVL P, Ø -7	Data Available - Term identifying data is positioned at the read head and is ready to be clocked into the formatter.
CDATX	Corrected Data Multiplexed - Data byte that is sent to the output register in serial form.
DCLK1	Data Clock 1 - Alternate input to the formatter read clock circuitry. Used in the event of data dropout in Read Channel 2.
DCLK2	Data Clock 2 - Primary input to the formatter read clock circuitry. Synchronizes PE clock to the data rate.

DINLOW — Data In Low - Enables write data to be clocked into the formatter from the controller.

ENFMG — Enable File Mark and Gap - Enables File Mark and Id Burst outputs from the formatter, as well as Block Detect to the Z80.

ENRD — Enable Read - Enables read strobes and data output from the formatter.

FRC 1, 2, 3 — Flux Reversal Control Lines - These lines determine the write formatter mode of operation. The following chart describes how they are used:

Command	FRC1	FRC2	FRC3
Write ID Burst	1	Ø	Ø
Write File Mark	1	Ø	1
Write Data	1	1	1

FSEL — Formatter Select - This signal indicates drive is selected by comparing the unit number of the drive to the IFAD and ITAD lines. FSEL enables drive status information (IONL, IRDY, etc.) to be sent to the controller.

FWD — Forward - This signal indicates forward tape motion to the read formatter logic. When tape is moving in the reverse direction, the read data will be inverted.

HIGH RATE — High Rate - This signal is a phase clock used by the formatter when the drive is selected for 100-ips operation.

INT* — Interrupt Request - Input, active low generated by CTC and PIO. INT* will be serviced by Z80 at the end of the current instruction.

IOREQ* — PIO Input/Output Request from Z80-CPU (input, active low) - The IOREQ* signal is used in conjunction with the B/A Select, C/D Select, CE*, and RD* signals to transfer commands and data between the Z80-CPU and the Z80-PIO. When CE* , RD* and IORQ* are active, the port addressed by B/A will transfer data to the CPU (a read operation). Conversely, when CE* and IORQ* are active but RD* is not active, then the port addressed by B/A will accept from the CPU, either data or control information as specified by the C/D Select signal. Also, if IORQ* and M1* are active simultaneously, the CPU is acknowledging an interrupt and the interrupting port will automatically place its interrupt vector on the CPU data bus if it is the highest device requesting an interrupt.

IS — Supply Servo Current - This signal represents the supply servo current.

IT	Takeup Servo Current - This signal represents the takeup servo current.
LASTW*	Last Word - This signal indicates the last data character to be written is present on the interface. It is also used to terminate the variable length erase operation.
MREQ*	Memory Request - Tri-state output active low signal which indicates that the address bus holds a valid address for a memory read or write operation.
MI*	PIO Machine Cycle One Signal from CPU (input, active low) - This signal from the CPU is used as a sync pulse to control several internal PIO operations. When MI is active and the RD signal is active, the Z80-CPU is fetching an instruction from memory. Conversely, when MI is active and IORQ is active, the CPU is acknowledging an interrupt. In addition, the MI signal has two other functions within the Z80-PIO. 1. MI synchronizes the PIO interrupt logic. 2. When MI occurs without an active RD or IORQ signal the PIO logic enters a reset state.
PECLK	Phase Encode Clock - Clock (22 times the data rate) that is used to synchronize the data in the formatter.
PENAB*	Phase Encode Enable - This signal enables formatter to send read strobes and data information.
POSTCHR	Post Character - This signal identifies detection of the Postamble.
PSEL	Parity Select - This signal gates parity channel from the read logic to the formatter.
PULSE Ø	Pulse Ø - This signal enables the I/O Control register.
PULSE 1	Pulse 1 - This signal sets the on-line flip-flop.
PULSE 2	Pulse 2 - This signal resets the rewind flip-flop.
PULSE 3	Pulse 3 - This signal sets the rewind flip-flop.
PULSE 4	Pulse 4 - This signal resets the on-line flip-flop.
PULSE 5	Pulse 5 - This signal is used to enable the formatter.
PULSE 6	Pulse 6 - This signal trigger is used in the error routine for troubleshooting the drive.
PULSE 7	Pulse 7 - This signal trigger is used in the error routine when outputting RAM to the data bus.

P0A0	PIO input which represents the IREV interface line.
P0A1	PIO input which represents the IWRT interface line.
P0A2	PIO input which represents the IWFM interface line.
P0A3	PIO input which represents the IEDIT interface line.
P0A4	PIO input which represents the IERASE interface line.
P0A5	PIO input which represents the IHISP interface line.
P0A6	Reserved for future use.
P0A7	Reserved for future use.
P0B0	PIO input which represents the IFEN interface line.
P0B1	PIO input which represents the IGO interface line. POASTR* strobes the command into the PIO.
P0B2	PIO output which, when high, selects the 3200 bpi mode of operation.
P0B3	PIO output which, when low, enables the erase head.
P0B4	PIO output which, when low, enables the write head.
P0B5	PIO output which, when high, selects the high speed (100 ips) mode of operation, and when low selects the low speed (25 ips) mode of operation.
P0B6	PIO output which indicates EOF (end of file) or the completion of a write bock.
P0B7	PIO output which, when high, selects the normal mode of write operation.
P1A0-P1A7	PIO inputs which represent counter values; P1A0 (LSB), P1A7 (MSB) used by the Z80 to determine tape speed (nominal binary count of 200).
P1B0-P1B1	PIO inputs which are used by the Z80 to determine the tachometer phase.
P1B2-P1B3	PIO outputs which, when active, enable the Z80 to prescale the tachometer for the following speeds:

00: 100 ips

10: 50 ips

11: 25 ips

P1B4-P1B7	PIO inputs which, when active, are used by the Z80 to calculate tape position.
P2A0	PIO input which, when high, indicates no tape in path.
P2A1	PIO input which pulses low to indicate the presence of a write enable ring.
P2A2	PIO input which, when high, indicates that the front panel door or top cover is open.
P2A3	PIO output which, when low, enables the servos.
P2A4	PIO output which, when low, enables the supply servo loop sense.
P2A5	PIO output which, when high, selects the supply servo voltage source.
P2A6	PIO output which, when high, selects the supply servo voltage or current drive.
P2A7	PIO output which, when high, selects the takeup servo voltage or current drive.
P2B0	PIO output which, when high, activates the door lock circuitry.
P2B1	PIO output which, when high, activates the hub lock circuitry.
P2B2	PIO output which, when high, enables +30Vdc to the servo circuits.
P2B3	PIO output which, when low, enables -30Vdc to the servo circuits.
P2B4	PIO output which, when low, activates the blower motor circuitry.
P2B5	PIO output which, when high, deactivates the system failure mechanism.
P2B6-P2B7	PIO outputs which, when high, select one of the following PE write modes of operation: 00: Clear 01: End of File 10: Identification Burst 11: Data Block
P3A0	PIO output which, when high, asserts the ISPEED interface line.
P3A1	Reserved for future use.

P3A2	PIO input which, when high, indicates Gap Detect.
P3A3	PIO input which, when high, represents the IFMK interface line.
P3A4	PIO input which, when high, represents the IONL interface latch.
P3A5	PIO input which, when high, represents the IRWD interface latch.
P3A6	Reserved for future use.
P3A7	PIO input/output which, when low, enables the servo motor shorting relay.
P3B0-P3B4	PI0 outputs which enable the switch panel indicators and the PIO inputs which represent the front panel switches
P3B5	Reserved for future use.
P3B6	PIO output which, when high, enables the RNOISE circuitry.
P3B7	PIO output which, when low, enables the +5Vdc noise injection circuitry.
P_ARDY	This signal indicates the PIO is ready to accept information.
P_ASTR*	This signal clocks PIO causing input information to be latched. When the PIO is enabled an interrupt will occur.
RD*	Memory Read - (Tri-state active low) - RD* indicates that the CPU wants to read data from memory or an I/O device.
RDATA P, 0-7	Read Data - These signals are the nine data lines being read off tape.
RDROP P, 0-7*	Read Drop - This signal indicates the loss of data for a minimum of four character times. Used for block, file mark, and ID Burst detection.
RES*	Reset - Input to the Z80, active low signal that forces program counter to zero and initializes the CPU.
RNOISE	Read Noise - This signal injects a 500-kHz low amplitude signal into the read amplifiers, used for diagnostic firmware.
SCAN P, 0-7	This signal selects which data channel will be multiplexed into the formatter.
SIDR	Supply Input Drive - The drive could be operating on either the current or voltage mode depending upon the feedback enable.
SMDH	Supply Motor Drive High - This signal is used for the supply motor drive voltage.

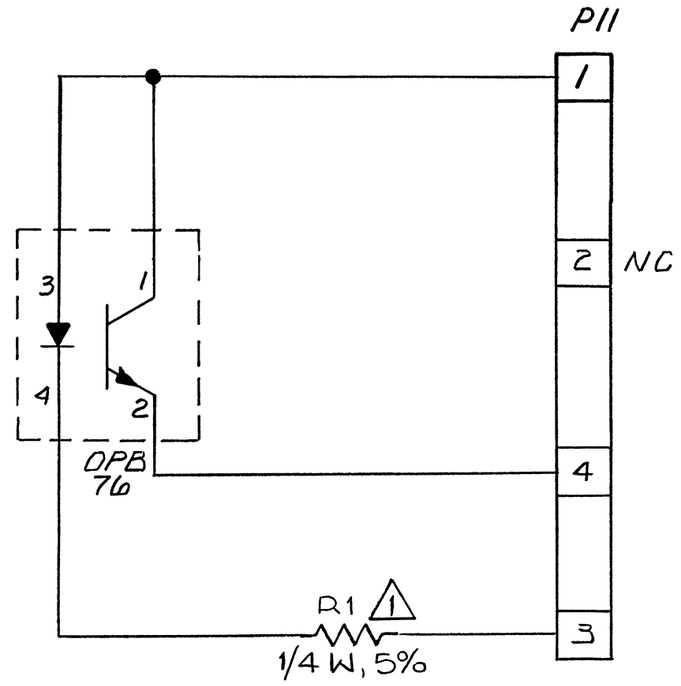
SMDL	Supply Motor Drive Low - This signal is used for current sense.
STRBX*	This signal enables read strobes and read data from the formatter. Used to disable read strobes when the postamble has been detected.
TIDR	Takeup Input Drive - The drive could be operating in either the current or voltage mode depending upon the feedback mode.
TMDH	Takeup Motor Drive High - This signal is used for the takeup motor drive voltage.
TMDL	Takeup Motor Drive Low - This signal is used for current sense.
VCOM	Read Threshold Voltage - VOUT 0 will change the read threshold during a read or write operation.
VHMON*	Voltage High Minus ON - This signal enables -30 volts to the takeup and supply motors.
VHPON	Voltage High Positive ON - This signal enables +30 volts to the takeup and supply motors.
VIN0	Voltage Input Zero - This signal is input voltage from the EOT sensor.
VIN1	Voltage Input One - This signal is input voltage from the BOT sensor.
VIN2	Voltage Input Two - This signal is input voltage from the compliance arm transducer logic.
VIN3	Voltage Input Three - This signal is used to determine supply servo EMF and voltage.
VIN4	Voltage Input Four - This signal is used to determine takeup servo EMF and voltage.
VIN5	Voltage Input Five - This signal is used to determine supply servo current.
VIN6	Voltage Input Six - This signal is used to determine takeup servo current.
VOUT0	Voltage Output Zero - This signal controls the read threshold voltage.
VOUT1	Voltage Output One - This signal controls the compliance arm offset voltage into the supply servo logic.
VOUT2	Voltage Output Two - This signal is the supply servo voltage control.

VOUT3	Voltage Output Three - This signal is the supply servo current limit control.
VOUT4	Voltage Output Four - This is a takeup servo voltage control.
VOUT5	Voltage Output Five - This is a takeup servo current limit control.
WAIT*	When active (low) this signal causes the Z80 to go into the wait state. The wait state is only used to send or receive data from the DAC.
WR*	Memory Write-Tri-state (active low). This signal indicates that the CPU data Bus (D0 - D7) holds valid data which is to be stored in memory or an I/O device.
WSTROBE	This signal is a clock that latches the write data into the formatter.
W2XCLK	Write 2 Times Clock - This signal clocks the data to the write head.
θ	System Phase Clock - This signal is a two megahertz clock used for the microprocessor circuitry.
θ1M	One Megahertz Clock - This signal is a one megahertz clock used for the microprocessor circuitry.
VIN7	Voltage Input Seven - This signal is used to determine the supply motor offset voltage.
V30P	Voltage 30 Positive - Positive 30Vdc drive voltage for the reel servo circuits (clockwise rotation).
V30M	Voltage 30 Minus - Negative 30Vdc drive voltage for the reel servo circuits (counter-clockwise rotation).
V20P	Voltage 20 Positive - Positive 20Vdc drive voltage for the reel servo circuits (clockwise rotation).
V20M	Voltage 20 Minus - Negative 20Vdc drive voltage for the reel servo circuits (counter-clockwise rotation).
VT	Voltage Takeup - This signal represents the takeup motor voltage feedback.
VS	Voltage Supply - This signal represents the supply motor voltage feedback.
V10P	Voltage 10 Positive - This signal is the positive 10Vdc from the power supply that is used to generate the +5Vdc signal.
V7AC	Voltage 7 Alternating Current - This signal is the AC input for the +5VCC noise injection circuitry.

DAVLX	Data Available Multiplexed - This signal is used to input the serialized data into the skew buffer.
DATA0X	Data Zeroes Multiplexed - This signal represents the serialized data bits input into the skew buffer.
CHDROPX	Channel Dropped Multiplexed - This signal represents the multiplexed channel drop signals.
DROP1	Drop One - This signal indicates that a single channel drop out has occurred.
FERR	Format Error - This signal asserts the IHER line following a parity error or a non-zero character in the postamble.
CHDT	Channel Detect - This signal is true if two or more channels are active and will assert IHER if a gap is not detected following the postamble.
HER*	Hard Error - This signal indicates excessive postamble length.
VRCCHR	Parity - This signal indicates the calculated parity of the byte being transferred to the interface.
DCLK	Data Clock - This signal is synchronized with CDATX data to generate IRSTR.
DOUT	Data Out - This signal is used to enable the output from the skew buffer.

360101-309 REV C

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR-RELEASE	RA	1/31/80	MT	2/20/80
B	INCORP ECO 9223	RL	5/2/80	SH	5-23-80
C	INCORP ECO 17782	CW	8/1/84	MO	8-4-84



NOTES:

1. RESISTOR VALUE IS DETERMINED AT THE TIME OF ASSEMBLY. SEE P/L NO. 160101-005 FOR ACCEPTABLE VALUES.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
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DECIMALS .XX = ± ~ .XXX = ± ~
ANGLES ± ~

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APPROVALS		DATE
DWN	R. Abad	1-30-80
CHK	R. Doss	2-19-80
MECH ENG		2-20-80
ELEC ENG		2-20-80
MFG ENG		2-11-80
QC		2-11-80
DOC CHK	Mary Simmons	2-20-80

Cipher Data Products SAN DIEGO CALIF.

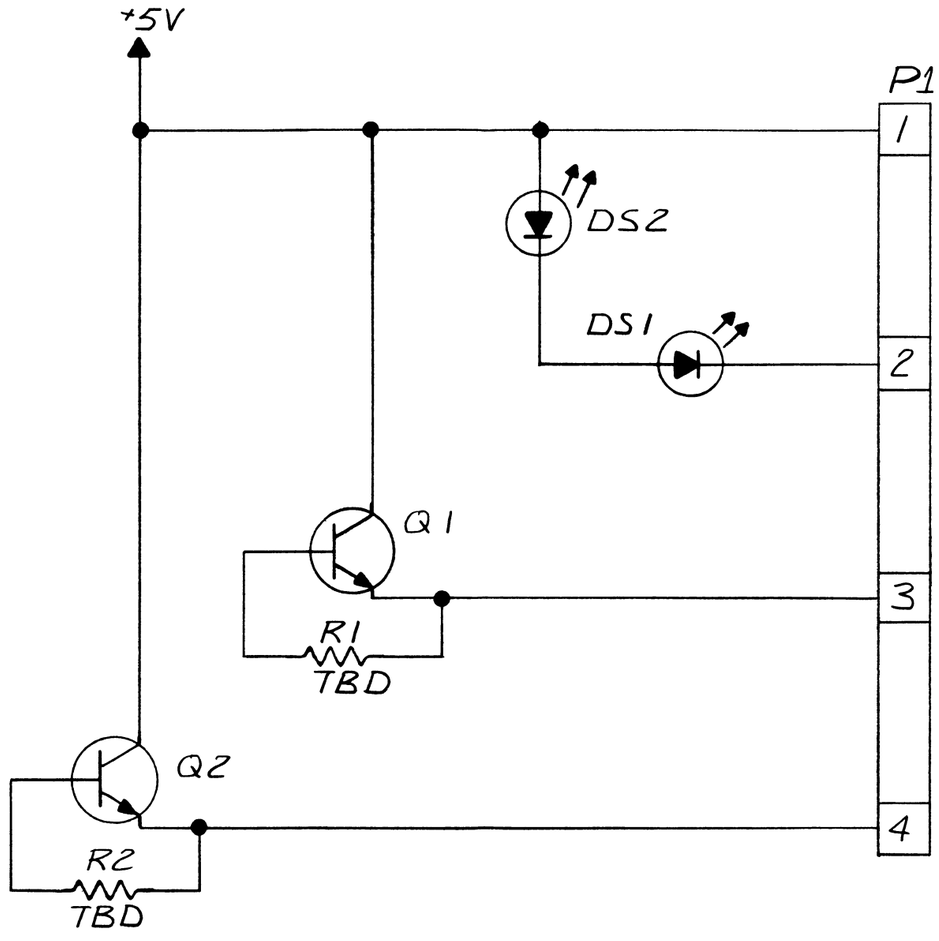
TITLE: SCHEM - FILE PROT. SENSOR

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B	32274	360101-309	C

SCALE NONE SHEET 1 OF 1

360102-319 REV B

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR. RELEASE	SS	3/13/81	MTT	3/19/81
B	INCORP ECO 13040	UA	5/28/82	[illegible]	5-28-82



1. 160101-010 CONTAINS DS1 ONLY.

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APPROVALS		DATE
DWN	SCHNEIDER	3-13-81
CHK	Mary Timmons	3/17/81
MECH ENG		3-18-81
ELEC ENG		3-18-81
MFG ENG		3-17-81
QC		3/19/81
DOC CHK	Mary Timmons	3/19/81

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TITLE: SCHEM- REFLECTIVE SENSOR

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B	32274	360102-319	B

SCALE ~ ~ SHEET 1 OF 1

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENGR. RELEASE	LL	4/6/80	MT	4/6/80
B	INCORP ECO 7851	RL	7/2/80	[illegible]	7-21-80
C	INCORP ECO 8028	LS	8-13-80	[illegible]	8-14-80

P3

GND	1	WHT	J7 9 GND
-20VDC	2	WHT	J7 3 -20VDC
GND	3	WHT	J7 8 GND
+20VDC	4	WHT	J7 12 +20VDC
GND	5	WHT	J7 7 GND
+9VDC	6	WHT	J7 15 +9VDC
GND	7	WHT	J7 5 GND
-30VDC	8	WHT	J7 10 -30VDC
GND	9	WHT	J7 4 GND
+30VDC	10	WHT	J7 13 +30VDC
GND	11	WHT	J7 6 GND
7VAC	12	WHT	J7 14 7VAC
DOOR LOCK RTN	14	WHT P16 / WHT P15	DOOR LOCK
+20VDC (LOCK)	13	WHT P18 / WHT P17	HUB LOCK
HUB LOCK RTN	15		

J7 11 N.C.

POWER SUPPLY PWA

J7 1 BLOWER RELAY

J7 2 BLOWER RELAY

P4

FPT RING SENSOR GND	1	GRN	P11 2 / 3 / 1 / 4 FILE PROTECT SENSOR
FPT RING SENSOR +5V	2	GRN	
FPT RING SENSOR RTN	7	GRN	
OPTICAL TACH GND	3	RED	P14 1
OPTICAL TACH +5V	4	BLK	P14 3
OPTICAL TACH RTN-A	8	WHT	P14 2
OPTICAL TACH RTN-B	10	GRN	P14 4 OPTICAL TACH
NOT USED	12		
COMP. ARM GND	5	BLU	P19 GND
COMPLIANCE ARM SOURCE	6	BLK	P20 CONTACTS
COMPLIANCE ARM RTN	20	WHT	P21 COMPLIANCE ARM
TAPE IN PATH +5V	12	BLU	P12 4
TAPE IN PATH SENS. RTN	9	BLU — 23 TAPE IN PATH SENSOR / 22	P12 3 TAPE IN PATH SENSOR
TAPE IN PATH LED GND	11	BLU	
DOOR SENSOR GND	13	WHT	P22 DOOR LOCK MICRO SWITCH
DOOR SENSOR RTN	14	WHT	
BOT/EOT SENSOR +5V	15	ORN	P23 1
BOT/EOT SENSOR GND	16	ORN	P23 2
BOT/EOT SENSOR RTN Ø	17	ORN	P23 3
BOT/EOT SENSOR RTN 1	18	ORN	P23 4 P13 BOT/EOT SENSOR
NOT USED	21		
NOT USED	19		

P5

BLOWER RELAY GND	1	WHT	J7 1 BLOWER RELAY
BLOWER RELAY (+)	2	WHT	J7 2 BLOWER RELAY
TAKE UP MOTOR (+)	3	WHT	P24 TAKE UP MOTOR
TAKE UP MOTOR COM	5	WHT	P25 TAKE UP MOTOR
SUPPLY MOTOR COM	4	WHT	P26 SUPPLY MOTOR
SUPPLY MOTOR (+)	6	WHT	P27 SUPPLY MOTOR
GND	7	YEL	P10 1 GND
LED 5	8	YEL	P10 6 GND
SW 5	9	YEL	P10 4 LED5
LED 4	10	YEL	P10 2 SW5
SW 4	11	YEL	P10 5 LED4
LED 3	12	YEL	P10 3 SW4
SW 3	13	YEL	P10 8 LED3
LED 2	14	YEL	P10 9 SW3
SW 2	15	YEL	P10 10 LED2
LED 1	16	YEL	P10 12 SW2
SW 1	17	YEL	P10 11 LED1
+5V	18		P10 13 SW1
			P10 14 +5V
			P10 7 N.C.

CHASSIS GND P28 — BRN — TP6 GND

P10 FRONT PANEL TOUCH SWITCH

360101-320 REV C

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APPROVALS		DATE
DWN	L. LIPTAK	4-23-80
CHK	[illegible]	6/24/80
MECH ENG	[illegible]	6-25-80
ELEC ENG	[illegible]	6/26/80
MFG ENG	[illegible]	6-25-80
QC	[illegible]	6-25-80
DOC CTRL CHK	[illegible]	6/25/80

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TITLE: SCHEM - HARNESS

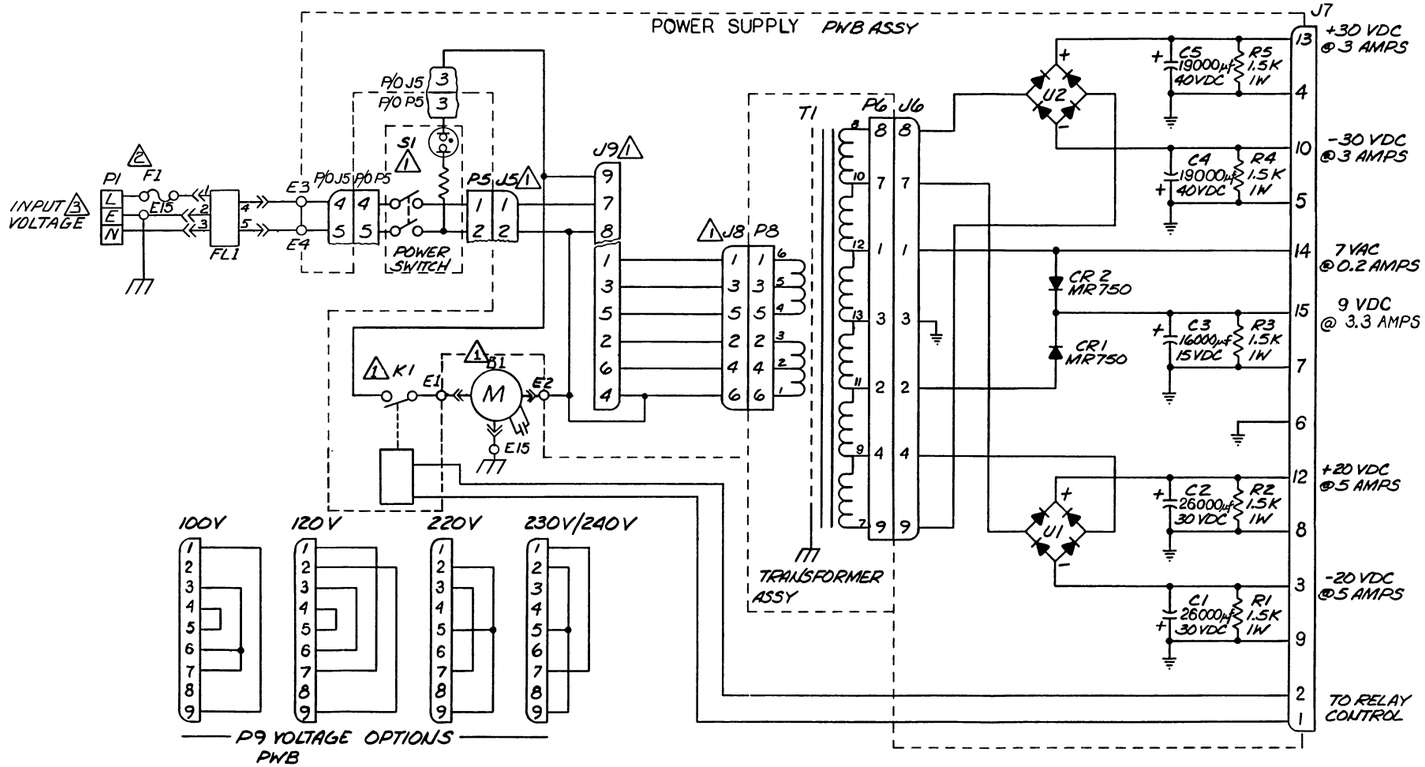
SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	360101-320	C

SCALE NONE SHEET 1 OF 1

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	PROD REL ERO 50-0268	VA	7-1-93	SJ	7-6-93

△2 △3 TABLE 1

INPUT VAC	FUSE REQUIRED
100V	3 AG 3 AMP
120V	
220V	3 AG 1½ AMP
230V	
240V	



△3 FOR INPUT VOLTAGE SEE TABLE 1.
△2 FOR FUSE SELECTION SEE TABLE 1.
△1 PARTS NOTED AFFECT UL RECOGNITION.

NOTES:

960877-300 REV A

REV STATUS	REV	A
OF SHEETS	SH	1

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APPROVAL	DATE
DWN	5-28-93
CHK	5-28-93
DES ENG	3-30-93
SAFETY	4/6/93
DES MGR	—
MFG ENG	3/31/93
ISSUED	4-6-93

cipher data products, inc. SAN DIEGO CALIF

TITLE: SCHEMATIC — POWER SUPPLY

CODE IDENT	SIZE	DWG NO	REV
32274	D	960877-300	A

SCALE — MOD — SH 1 OF 1

BRUNING 4922

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REVISION						
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENG REL ERO SC-0010	EC	4/23	CK	4/23/83
B	INCORP ECO 16878	EC	5-27-83	MK	6/1/83
C	INCORP ECO 16935	EC	7/10/83	MK	7/16/83
D	INCORP ECO 16932	EC	7/10/83	MK	7/16/83
E	INCORP ECO 17073	EC	8/18/83	MK	8-26-83
F	INCORP ECO 17235	EC	8-26-83	MK	9-2-83
G	INCORP ECO 17504	CW	9/15/83	MK	9-22-83
H	INCORP ECO 17597	CW	9/16/83	MK	9-27-83
J	INCORP ECO 17640	CW	9/28/83	MK	9-30-83
K	INCORP ECO 17723	CW	9/28/83	MK	10-6-83
L	INCORP ECO 17617	CW	9/28/83	MK	9-30-83
M	INCORP ECO 17484	CW	9/28/83	MK	9-30-83
N	INCORP ECO 18030	CW	10/26/83	MK	10-27-83

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. IC Vcc & GND PINS, UNUSED PORTIONS:

a. +5R, +5V DEVICES:

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
SN74LS00N	U1J, U2V, U3V, U5V, U10P, U11B, U11C, U11E, U11F, U12E, U18T		14	7	U18T-C
SN74LS02N	U3L, U17N		14	7	U3L-D
74HCT04	U8R		14	7	
SN74LS04N	U3J, U4W, U5W, U7H, U8A, U8B, U8C, U17T		14	7	U17T-E
SN7406N	U17J		14	7	
SN7407N	U10H, U18J, U18K		14	7	U10H-F
SN74LS08N	U4P, U4V, U10V		14	7	
SN74 S10N	U5F		14	7	
SN74LS10N	U17M		14	7	
SN74LS11N	U2J,		14	7	U2J-A
SN74LS14N	U14B, U14D, U14G		14	7	
SN74LS32N	U11V		14	7	
SN74S140	U2G		14	7	U2G-B
SN74LS38N	U3K, U4R, U17W, U8V, U9V U17V, U18X, U20X, U17X		14	7	
SN74LS74N	U1H, U9R, U17R, U18M		14	7	
SN74LS86N	U6W, U12B, U12C, U12D, U12F, U12G, U13W, U14W, U15W		14	7	U6W-D U14W-D
SN74LS109N	U2H, U5H, U6A, U6B, U7A, U7B, U13B-C-E-F-H-V		16	8	U13V-B
SN74LS123N	U2K, U4N		16	8	
SN74LS138N	U2W, U8D		16	8	
SN74LS139N	U9P		16	8	
SN74LS151N	U7C, U10F, U10G,		16	8	
SN74LS153N	U7E		16	8	
SN74LS157N	U9E		16	8	
SN74LS163AN	U3H, U7D, U9A, U9B, U9C, U9D, U10B, U10C, U10D, U10E, U10R, U11P, U11R, U12P, U14V, U15V, U17P, U18P, U18R, U11D		16	8	
SN74LS164N	U7F, U8E, U8F, U9F, U19V		14	7	
SN74LS169AN	U18N		16	8	
SN74LS174N	U6F, U6G, U11W, U12R, U12V, U13A, U13D, U13G, U17K, U19W, U19X, U7V		16	8	
SN74LS175N	U12W, U18L, U18V, U18W		16	8	
SN74LS197N	U8P		14	7	
SN74LS280N	U9W		14	7	
SN74LS368A	U17L		16	8	U7L-D
SN74LS221	U17W		16	8	
Z80CPU	U6L		11	29	
Z80CTC	U14N		24	5	
Z80PIO	U8L, U10L, U12L, U14L		26	11	
339	U6H, U19T		3	12	
7411	U6V		19	7	

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
82S129	U7G		16	8	
2111A	U6P, U7P		18	8	
2716	U6N, U8N, U10N, U12N		24	12	
MC4024	U3G		14	7	
MC4044	U5G		14	7	
6305	U12H		16	8	
6336-1	U9G, U14R		24	12	
RESISTOR PACK	U3W, U10W		16	8	

b. -6V, +5V DEVICES:

IC TYPE	REFERENCE DESIGNATOR	-6V	+5V	GND	UNUSED
4051	U2N U2R	7	16	8	
4053	U3B, U4B	7	16	8	

c. -12V, +12V & MISC

IC TYPE	REFERENCE DESIGNATOR	-12	+12	GND	V-20P	UNUSED
339	U1K			12	3	
DAC08	U3N	3	13	1		
319	U14C, U14F, U14H, U15A, U15C, U15D, U15F, U15G, U15H	6	11			
709P	U19A, U19B, U19C, U19D, U19E, U19F, U19G, U19H, U19I	4	7			
4136	U3A, U3D, U3E, U5E, U20N	7	11			U5E-A,C, U20N-C,D, U22N-A,B
TL082	U17A, U17B, U17C, U17D, U17E U17F, U17G, U17H, U17I	4	8			
TL084	U2M, U3M	11	4			

4. LAST USED REFERENCE DESIGNATOR:

C	241	K	1	S	—	VR	2
CR	23	P	7	TP	97	Y	1
DS	1	Q	40	U	—	L	1
J	1	R	376			W	19

5. DIP SWITCH U8W

POSITION	FUNCTION
S1	FORMATTER ADDRESS (SEE TABLE)
S2	TRANSPORT ADDRESS SEE TABLE
S3	RESERVED
S4	TRANSPORT ADDRESS SEE TABLE
S5	C=EXTERNAL PARITY SELECT (S6 OPEN)
S6	C=INTERNAL PARITY GENERATION (S5 OPEN)
S7	RESERVED
S8	RESERVED

C = CLOSED

ADDRESS LINE DECODING TABLE

IFAD	ITAD 0	ITAD 1	S1	S2	S4	ADDRESS
0	0	0	1	1	1	0
0	0	1	1	1	0	1
0	1	0	1	0	1	2
0	1	1	1	0	0	3
1	0	0	0	1	1	4
1	0	1	0	1	0	5
1	1	0	0	0	1	6
1	1	1	0	0	0	7

0 = FALSE INTERFACE LEVEL 0 = OPEN
1 = TRUE INTERFACE LEVEL 1 = CLOSED

6. JUMPER OPTION: W1, 17, 16 & 19 ARE "IN"
W14, 17, 18 ARE "OUT" (CUT ETCH AS REQUIRED)

⚠1 ALTERNATE SCHEM SECTION (DETAIL "A") TO BE USED WITH PWB ASSY 960719-002

960725-300 REV N

REV STATUS	REV	N	L	F	A	N	M	F	A	L	H
OF SHTS	SHT	1	2	3	4	5	6	7	8	9	10

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: DECIMALS XX ± .1, XXX ± .2; ANGLES ±

APPROVALS — DATE
DWN E. Compagni 6/1/83
CHK M. Gyebnar 6/1/83
MECH ENG 6/1/83
ELEC ENG 9 Jones 6/21/83
MFG ENG 6/23/83
QC
PROJ ENG 6/23/83

DO NOT SCALE DRAWING

Cipher Data Products SAN DIEGO CALIF

TITLE SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN

SIZE D | CODE IDENT NO. 32274 | DRAWING NO. 960725-300 | REV N

SCALE NONE | SHEET 1 OF 10

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960725-300 REV L

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

U6P 2111A · U7P 2111A · U8P LS197 · U8L Z80 PIO · U12L Z80 PIO · U14L Z80 PIO · U10L Z80 PIO · U6L Z80 CPU · U6N 2716 (0-2K) · U8N 2716 (2K-4K) · U10N 2716 (4K-6K) · U12N 2716 (6K-8K) · U9P LS139 · U14N Z80 CTC · U8R 74HCT04 · U8W · U10P LS00 · U12V LS00 · U5F LS10 · U7H LS04 · Y1 8.00 MHz

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX = ± XXX = ± ANGLES ±	APPROVALS DWN CHK MECH ENG ELEC ENG MFG ENG QC DOC CHK — DATE
DO NOT SCALE DRAWING	Cipher Data Products, San Diego, Calif.
TITLE	SCHEM-BASIC, DRIVE/FMTR, DAISY CHAIN
SIZE D	CODE IDENT NO. 32274
DRAWING NO.	960725-300
PPV L	
SCALE NONE	SHEET 2 OF 10

960725-300 REV F

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

+12V R335 6.04K 1% U3N DACO8 R332 1K R333 2.61K 1/8W R334 6.2K C163 .01 -12V U3J LS04 AI5 (2) AB A9 A10 A11 A12 A13 A14 TL084 U2M R322 2.49K, 1% R327 330 +5V -6V R355 20K R354 20K R353 20K AO A1 A2 (2) U2N 4051 XIN INHIBIT Y0 Y1 Y2 Y3 Y4 Y5 Y6 C152 .001 C153 .001 C154 .0022 C156 .01 C160 .001 C155 .01 C159 .0022 TL084(6) +12V U3M U2M 4136 U5E R336 51K VOUTØ (7) VOUT1 VOUT2 VOUT3 VOUT4 VOUT5 (4) R373 10K 1% CR22 IN914 CR23 IN914 VINØ (5) VIN1 (5) VIN2 (4,5) VIN3 VIN4 VIN5 VIN6 VIN7 R343 1K R342 1K R390 1K R394 10K 1% R339 1K R337 1K R338 1K R391 100K C169 .1 C167 .1 C168 .1 C169 .1 C171 .1 C170 .1 C165 .01 U2R 4051 XOUT INHIBIT Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7 A B C +5V -6V TL084 U2M C225 .001 R350 22K +5V CR19 IN914 CR18 IN914 U4R LS38 D7 (2) +5V R357 20K RD U3J LS04 U4P LS08 C158 220pF R349 51K +5V A5(2) IOREQ (2) U3L LS02 U4N LS123 CEXT RCEXT 2B 2A CLR 1Q 2Q C157 220pF R348 15K WR(2) WAIT (2) RD (2) TP60 R356 1.5K

P1 +5V(TO 220Ω) U3W TO 330Ω 220/330 IREV IWRT IWFM IEDIT IERASE RESERVED RESERVED IGO ITADO IREW U8W U10W +5V R367 10K R365 10K R369 10K +5V LS86(3) U6W 7411 FSEL U5V LS00 POB1, POASTR (2) POBO (2) U5W LS04 U4W LS04 P2 IHSP ITADI IRWU IFAD IFEN

LS04(9) POA0 POA1 POA2 POA3 POA4 POA5 POA6 POA7 (2) U5W U4W

A2 A1 A0 IOREQ WR LS138 U2W G2A G2B G1 A7 (2) PULSE Ø PULSE 1 PULSE 2 PULSE 3 PULSE4 PULSE 5 (10) PULSE 6 N/C PULSE 7 N/C

TP79 FSEL U4V LS08 U2V LS00 U6V 7411 ONLSEL (6,9 & 10) W21 W20 SCLONL U18T U17T U3V LS00(2) P3A5(2) U10V LS08 TP80 TP81 TP87 U5W LS04

LS174 U7V CK D0 D1 D2 D3 D4 D5 Q RES (2,5,6 & 10) TP85 TP78

POARDY(2) TP77 TP84 U3V LS00 TP82 TP86 TP83 LS38(10) U7W U8V U9V P3A0 (2) P3A1 (2) P3A4(2)

P1 2 IFBY 44 P2 28 IRDY 38 IDBY 32 IFPT 4 ILDP 22 IEOT 40 ISPEED 44 IONL 30 IRWD

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS .XX ± .XXX ± ANGLES ±	APPROVALS	DATE	Cipher Data Products SAN DIEGO CALIF.
DO NOT SCALE DRAWING	DWN CHK MECH ENG ELEC ENG MFG ENG QC DOC CHK		TITLE SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN
			SIZE D · CODE IDENT NO. 32274 · DRAWING NO. 960725-300 · REV F
			SCALE NONE · SHEET 3 OF 10

960725-300 REV A

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

SERVOS

VIN2 (3,5) · VOUT1 (3) · VOUT2 (3) · VOUT3 (3) · VOUT4 (3) · VOUT5 (3) · VIN5 (3) · VIN7 (3) · VIN4 (3) · VIN6 (3) · SMDH (5) · SMDL (5) · TMDH (5) · TMDL (5) · VIN3 (3) · SIDR · TIDR · VS · VT · IS · IT · TPØ · V30P · V30M · V20P · V20M · +5V · -6V · -12V · +12V · P2A4 (2) · P2A5 (2) · P2A6 (2) · P2A7 (2) · P2A3 (2) · P2B2 (2) · P2B3 (2)

U5E 4136 · U4B 4053 · U3D 4136 · U3A 4136 · U3B 4053 · U3E 4136 · INHIB

R55 100K 1% · R77 750K · R56 750K · R54 332K 1% · R53 499K 1% · R75 22.1K 1% · R74 15K · R76 4.7M · R27 20K · R28 20K · R49 8.66K 1% · R37Z 9.1K · R73 4.32K 1% · R96 330 · R29 20K · R48 3.92K 1% · R50 22.1K 1% · R47 4.75K 1% · R72 10K · R71 10K · R22 20K · R30 20K · R23 3.92K 1% · R24 3.92K 1% · R25 12.1K 1% · R69 22.1K 1% · R19 3.92K 1% · R18 4.75K 1% · R21 10K · R20 10K · R45 4.75K 1% · R70 4.75K 1% · R329 270 · R330 1K · R325 1W 1.5K · R331 220 · R324 1K · R323 1.5K 1W · R326 270 · R13 20K · R16 15K · R3 180K · R19 20K · R15 15K · R17 180K

C27 .12 · C31 100pF · C15 .068 · C30 .068 · C178 10 50V · C161 .01 · C5 .0015 · C6 .0015 · C13 200pF · C11 200pF · C179 10 50V · C151 .01

CR7 IN914 · CR8 IN914 · CR6 IN914 · CR5 IN914 · CR1 IN914 · CR2 IN914 · CR14 MRB20 · CR15 MR820

Q23 VHPON 2N4401 · Q6 2N6050 · Q13 2N4401 · Q12 2N3494 · Q3 2N6056 · Q15 2N4403 · Q4 2N6054 · Q14 2N2243 · Q9 2N4401 · Q8 2N3494 · Q1 2N6056 · Q2 2N6054 · Q11 2N4403 · Q10 2N2243 · Q22 VHMON 2N4403 · Q21 2N4401 · Q5 2N6057

R32 470 · R31 47 · R33 7.5K · R34 2.0K · R37 7.5K · R36 470 · R35 47 · R370 150Ω · R5 4.7K · C12 .33 · C223 330PF · R7 470 · R6 47 · R8 7.5K · R9 2.0K · R2 7.5K · R11 470 · R10 47 · R4 4.7K · C14 .33 50V · C224 330PF · R371 150Ω

R40 100K 1% · R58 100K,1% · C10 .082 · R57 80.6K 1% · R52 51K · R60 10K,1% · R44 10K · R42 1K · R59 10K 1% · R62 1K 1% · R61 10K, 1% · C16 .01 · R38 .1Ω 3W 1% · R41 100K 1% · R79 100K 1% · C28 .068 · R78 40.2K 1% · R65 62K · R51 10K · R43 1K · R64 10K,1% · R63 1K,1% · R66 10K 1% · R67 10K, 1% · C19 .01 · R39 .1Ω 3W 1%

TP13 · TP19 · TP18 · TP12 · TP25 · TP24 · TP20 · TP16 · TP22 · TP6 · TP14 · TP17 · TP23 · TP61

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS ANGLES XX ± ± XXX ± ±

APPROVALS · DATE · DWN · CHK · MECH ENG · ELEC ENG · MFG ENG · QC · DOC CHK · DO NOT SCALE DRAWING

Cipher Data Products SAN DIEGO CALIF.

TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	960725-300	A

SCALE NONE · SHEET 4 OF 10

960725-300 REV N

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

POWER CONTROL & SYSTEM FAILURE DETECT

INPUT SENSORS

SERVO SPEED & POSITION

SERVO POSITION SENSOR

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DO NOT SCALE DRAWING	DWN CHK MECH ENG ELEC ENG MFG ENG QC DOC CHK		TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN
			SIZE D · CODE IDENT NO. 32274 · DRAWING NO. 960725-300 · REV N
			SCALE NONE · SHEET 5 OF 10

960725-300 REV M

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

220/330 RESISTOR PACK

+5V TO 220Ω — U10W — TO 330Ω

P1: 1IWP 22, IW0 10, IW1 12, IW2 30, IW3 26, IW4 6, IW5 32, IW6 28, IW7 24, 1LWD 4

U11W LS174 — U12W LS175 — U9W LS280 (Σ ODD) — U8W

DINLOW — WSTROBE — LASTW

SEE DETAIL "A"

LS86 (9): U15W, U15W, U15W, U13W, U15W, U14W

U17K LS174 — U18L LS175 — W2XCLK — +5V

7406(6) (18) ½W

U17J	R239 360	P6 TO WRITE HEAD
U18J	R240 470	CHAN P
U17J	R235 360	CHAN 0
U18J	R236 470	CHAN 1
U17J	R244 360	CHAN 2
U18J	R237 470	CHAN 3
U17J	R238 360	CHAN 4
U18J	R245 470	CHAN 5
U17J	R246 360	CHAN 6
U18J	R241 470	CHAN 7
U17J	R242 360	
U18J	R233 470	
U18K	R298 470	
U18K	R299 360	
U18K	R243 470	
U18K	R234 360	
U18K	R247 470	
U18K	R250 360	

7407(6) ×2

FRC3 — FRC2 — FRC1

+12V

7407(4) U10H — RES (2,3,5,10) — R257 2.2K — Q37 2N3702 — R258 10K — R256 1.5K — Q38 2N6034

POB4 (2) — U10H — R255 4.7K — C188 1500pF

POB2 (2) — U10H — R254 3.3K — Q36 2N6034 — CR10 5.6V IN5232B — C186 .1 — P6: 20 WHEADCT, 21 ERASERET

+5V — R252 240 — Q35 2N3702

POB3 (2) — U10H — R253 1K — R251 33 — +C187 10 20V — P6: 22 ERASEDRV

POB6 (2)

W11 W10 W12 W13 — U10R LS163 — POB5 (2,7) — U14W LS86 — U10P LS00

W8 W9 — CLKBM (2)

W6 W7 — U11R LS163

U9R LS74 — BITCLK(9)

U11P LS163 — U14W LS86 — U4P LS08 — FRC3

P2B6 (2) — P2B7 (2) — U4V LS08 — FRC2

U12P LS163 — U10P LS00 — POB7 (2)

W2XCLK

U12R LS174 — U14R 6336-1 (DO1–DO8, E1, RES E4, E3)

U17M LS10 — U3J LS04 — U4V LS03 — U4R LS38 — P2: 36 IWSTR — ONLSEL (3,9&10)

W5 W4 — W12XCLK

U17K SOCKET

PWB ASSY 961294-001
SCHEMATIC 961294-300
PLD-X700 DWG 961447-001

E1 — U8L-34 — E2 — U10H-3

U15W-8 — U18J-11
U15W-11 — U18J-3, U18J-13
U15W-3 — U18J-1
U13W-6 — U18J-9
U15W-6 — U18J-5
U14W-6, U18L-9

U10P+ 15 +5V

DETAIL — A

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APPROVALS	DATE
DWN	
CHK	
MECH ENG	
ELEC ENG	
MFG ENG	
QC	
DOC CHK	

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Cipher Data Products, SAN DIEGO CALIF.

TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	960725-300	M

SCALE NONE — SHEET 6 OF 10

960725-300 REV F

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

IC VOLTAGES - TYP 9 PLACES

+12V / 709P / 7 / 4 / -12V

+12V / TL082 / 8 / 4 / -12V

+12V / 319 / 11 / 6 / -12V

POB5 (2,6) → U12F → U10H → 7407

POB5B(9) +12V → R113 2.2K → Q25 2N3702 → R112 4.7K → R114 1K

CHANNEL P

RNOISE

R199 20K, R199 33, R197 8, R196 10K, C101 .082, 10%, C99 10%, Q31 2N3704, R195 3.3K

C100 27pF, R198 3.3K, U19C 709P, C102 3pF, R197-1 7.5K 1/8W 1%, RM HEAD P

TP49, R193 15K, -12V

C103 47pF, R190 10K, U17F TL082, C104 .01 20%, R189 3.3K, R192 10K, C106 100pF

R191 4.7K, U15F 319, +5V, R122 4.7K, U14D LS14, RDATAP (8)

R125 4.7K, U14D LS14, RDROP P (8, 9), C87 .039 10%

VCOM

CHANNEL 2

R183 20K, R189 33, R186 8, R185 10K, C97 .082, 10%, C95 10%, Q30 2N3704, R189 3.3K

C96 27pF, R187 3.3K, U19B 709P, C93 3pF, R186-1 7.5K 1/8W 1%, RMHEAD 2

TP97, R182 15K, -12V

C92 47pF, R179 10K, U17E TL082, C91 .01 20%, R178 3.3K, R181 10K, C89 100pF

R180 4.7K, U14F 319, +5V, R126 4.7K, U14D LS14, RDATA2 (8)

R127 4.7K, U14D LS14, RDROP 2, C105 .039 10% (8, 9)

CHANNEL 5

R227 20K, R232 33, R230 8, R229 10K, C130 .082, 10%, C133 10%, Q39 2N3704, R228 3.3K

C134 27pF, R231 3.3K, U19J 709P, C129 3pF, R230-1 7.5K 1/8W 1%, RMHEAD 5

TP55, R226 15K, -12V

C128 47pF, R223 10K, U17I TL082, C127 .01 20%, R222 3.3K, R225 10K, C126 100pF

R224 4.7K, U15H 319, +5V, R133 4.7K, U14G LS14, RDATA5 (8)

R129 4.7K, U14G LS14, RDROP5, C124 .039 10% (8, 9)

TP94, TP97, C92 .047, VOUTφ(3), R115 2K

CHANNEL φ

RNOISE

R161 20K, R166 33, R164 8, R163 10K, C71 .082, 10%, C73 10%, Q28 2N3704, R162 3.3K

C74 27pF, R165 3.3K, U19C 709P, C70 3pF, R169-1 7.5K 1/8W 1%, RM HEAD φ

TP43, R160 15K, -12V

C69 47pF, R157 10K, U17C TL082, C81 .01 20%, R156 3.3K, R159 10K, C83 100pF

R158 4.7K, U15C 319, +5V, R117 4.7K, U14B LS14, RDATA φ (8)

R119 4.7K, U14B LS14, RDROP φ (8, 9), C51 .039 10%

VCOM

CHANNEL 3

R205 20K, R210 33, R208 8, R207 10K, C114 .082, 10%, C112 10%, Q32, 2N3704, R206 3.3K

C113 27pF, R209 3.3K, U19G 709P, C115 3pF, R208-1 7.5K 1/8W 1%, RMHEAD 3

TP51, R209 15K, -12V

C110 47pF, R201 10K, U17G TL082, C109 .01 20%, R200 3.3K, R203 10K, C108 100pF

R202 4.7K, U15G 319, +5V, R130 4.7K, U14G LS14, RDATA3 (8)

R128 4.7K, U14G LS14, RDROP3, C107 .039 10% (8, 9)

CHANNEL 6

R148 20K, R147 33, R145 8, R150 10K, C66 .082, 10%, C64 10%, Q27 2N3704, R149 3.3K

C65 27pF, R146 3.3K, U19B 709P, C67 3pF, R145-1 7.5K 1/8W 1%, RMHEAD 6

TP41, R151 15K, -12V

C68 47pF, R153 10K, U17B TL082, C56 .01 20%, R152 3.3K, R155 10K, C53 100pF

R154 4.7K, U14C 319, +5V, R120 4.7K, U14B LS14, RDATA6 (8)

R121 4.7K, U14C LS14, RDROP6, C82 .039 10% (8, 9)

VCOM

RNOISE

C93 .01, C139 .01, C94 1000pF, RNOISE (2)

CHANNEL 1

RNOISE

R170 20K, R168 33, R167 8, R172 10K, C78 .082, 10%, C76 10%, Q29 2N3704, R171 3.3K

C77 27pF, R169 3.3K, U19D 709P, C79 3pF, R167-1 7.5K 1/8W 1%, RMHEAD 1

TP45, R173 15K, -12V

C80 47pF, R175 10K, U17D TL082, C86 .01 20%, R174 3.3K, R177 10K, C85 100pF

R176 4.7K, U15D 319, +5V, R124 4.7K, U14D LS14, RDATA1 (8)

R123 4.7K, U14D (6 PLCS) LS14, RDROP1 (8, 9), C84 .039 10%

VCOM

CHANNEL 4

R139 20K, R143 33, R142 8, R141 10K, C62 .082, 10%, C60 10%, Q26 2N3704, R140 3.3K

C61 27pF, R199 3.3K, U19A 709P, C58 3pF, K192-1 7.5K 1/8W 1%, RMHEAD 4

TP39, R138 15K, -12V

C57 47pF, R135 10K, U17A TL082, C55 .01 20%, R134 3.3K, R137 10K, C52 100pF

R136 4.7K, U15A 319, +5V, R118 4.7K, U14B LS14, RDATA 4 (8)

R116 4.7K, U14B (6 PLCS) LS14, RDROP4, C54 .039 10% (8, 9), C125 .039 10%

CHANNEL 7

R216 20K, R221 33, R219 8, R218 10K, C121 .082, 10%, C119 10%, Q33 2N3704, R217 3.3K

C120 27pF, R220 3.3K, U19H 709P, C117 3pF, R219-1 7.5K 1/8W 1%, RMHEAD 7

TP53, R215 15K, -12V

C116 47pF, R212 10K, U17H TL082, C122 .01 20%, R211 3.3K, R214 10K, C123 100pF

R213 4.7K, U14H 319, +5V, R132 4.7K, U14G LS14, RDATA7 (8)

R131 4.7K, U14G (6 PLCS) LS14, RDROP7, C125 .039 10% (8, 9)

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APPROVALS: DWN, CHK, MECH ENG, ELEC ENG, MFG ENG, QC, DOC CHK — DATE

Cipher Data Products, SAN DIEGO CALIF.

TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN

SIZE D | CODE IDENT NO. 32274 | DRAWING NO. 960725-300 | REV F

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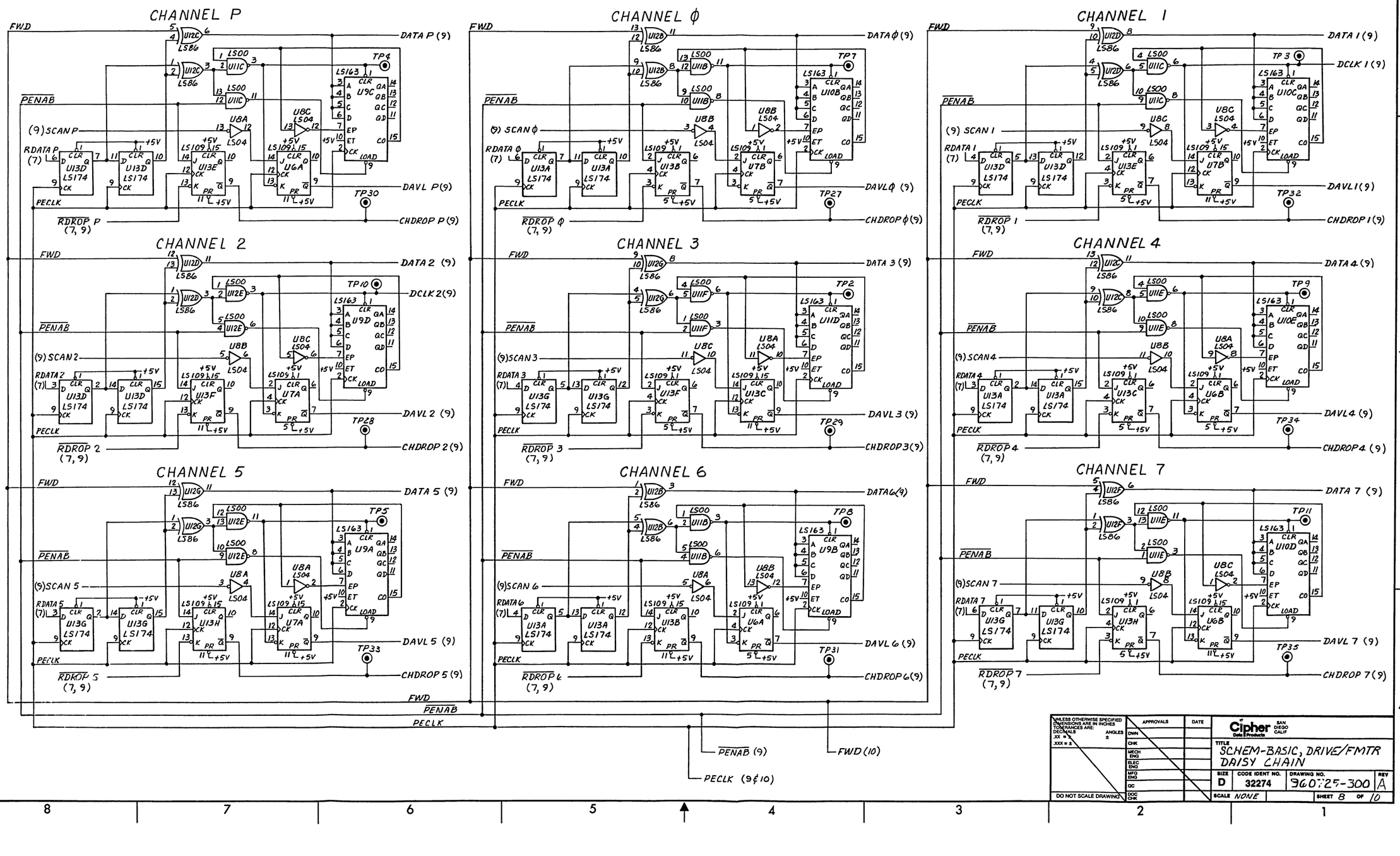
960725-300 REV

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE



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DO NOT SCALE DRAWING	DWN CHK MECH ENG ELEC ENG MFG ENG QC DOC CHK		TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN	
			SIZE: D · CODE IDENT NO.: 32274 · DRAWING NO.: 960725-300 · REV: A	
			SCALE: NONE · SHEET 8 OF 10	

960725-300 L

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

POB5B (7)

(8) DCLK2
(8) DCLK1
(6) BITCLK
CHDROP2
GAP
LS153 U7E
R90 100
C 29-1 330pF
U5G MC 4044
R84 1K
C20 .22
R85 1K
R86 1.5K
R87 1.5K
C21 .01
C26 47pF
U3G MC 4024 HIGH RATE
C18 .1
C 29 200pF 5%
U3G MC 4024
C17 .1
U2G 74S140
R374 82 Ω
L1 .47uH
R315 150Ω
C226 180pF
TP93
PECLK (8,10)
JUMPER W1
U9F LS164
U8F LS164
U8E LS164
U7F LS164
PECLK
PENAB
U6F LS174
W2 W3
U9G 6336-1
U3H LS163
U7D LS163
U12H LS109
U10J LS00
U8D LS138
SCANP (8)
SCAN0 SCAN1 SCAN2 SCAN3 SCAN4 SCAN5 SCAN6 SCAN7 (8)
R80 10K
U10H LS04
DROP1
U10V LS08
U12V LS174
DAVLX
DATAOX
DOUT
DATA
P/E2 E1
82S-129
U7G
U6G LS174
U6F LS174
POSTCHR
VRCCHR
DOUT
PSEL
U11V LS32
U11T LS04
U5F S10
U10V LS08
STRBX(10)
DCLK (10)
CDATX (10)
U9V LS38
U11F LS00
U2J LS11
U3J LS04
U1J LS00
FERR
U3J
74HCT04 U8R
'LS02 U3L
ONLSEL (3,6,10)
U11J LS00
PENAB
BLOCK
CHDT
HER
P3A6 (2)
U3K LS38
ENRD(10)
P3A2 (2)
ENFMG(10)
P3A3 (2)
U17X LS38
ONLSEL (SH. 3,6 & 10)
U3K
P2
42 ICER
12 IHER
14 IFMK
16 IDENT
(9)PENAB
U18T LS00
U13V LS109
U14V LS163
U15V LS163
U2H LS109
U5H LS109
U6H 339
U6H 339
U6H 339
U6V 7411
R83 3.92K 1%
R82 3.01K 1%
R93 10K
R94 10K
R95 10K
R92 10K
R107 220K
R109 220K
R111 220K
R110 220K
R108 220K
C38 1800pF
C37 1800pF
C35 1000pF
C36 .01
U12H 6305
(7,8)
RDROPP
RDROP0
RDROP1
RDROP2
RDROP3
RDROP4
RDROP5
RDROP6
RDROP7
P/E1
DAVL0
DAVL1
DAVL2
DAVL3
DAVL4
DAVL5
DAVL6
DAVL7
STROBE
U7C LS151
U10F LS151
U10G LS151
DATA0
DATA1
DATA2
DATA3
DATA4
DATA5
DATA6
DATA7
DATAP
DAVLP
CHDROPP(8)
CHDROP0
CHDROP1
CHDROP2
CHDROP3
CHDROP4
CHDROP5
CHDROP6
CHDROP7
U9E LS157
POB5B

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS XX = ± XXX = ±
ANGLES ±

APPROVALS: DWN, CHK, MECH ENG, ELEC ENG, MFG ENG, QC, DOC CHK
DATE

DO NOT SCALE DRAWING

Cipher Data Products SAN DIEGO CALIF.

TITLE: SCHEM-BASIC, DRIVE/FMTR DAISY CHAIN

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	960725-300	L

SCALE NONE SHEET 9 OF 10

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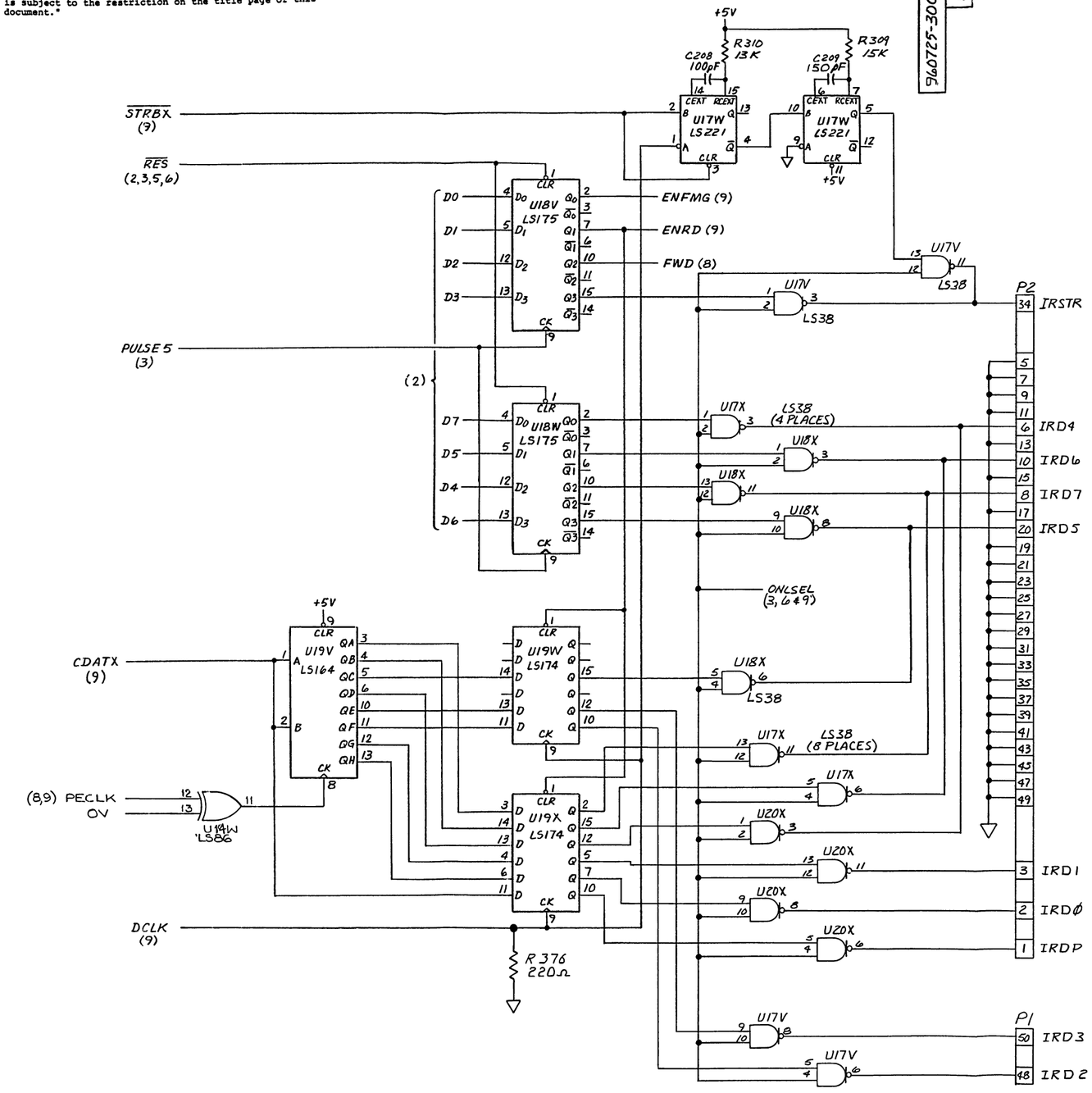
960725-300 H

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX ± XXX ± ANGLES ±	APPROVALS	DATE
DO NOT SCALE DRAWING	DWN	
	CHK	
	MECH ENG	
	ELEC ENG	
	MFG ENG	
	QC	
	DOC CTRL	

Cipher Data Products SAN DIEGO CALIF

TITLE: SCHEM-BASIC, DRIVE / FMTR DAISY CHAIN

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	960725-300	H

SCALE NONE SHEET 10 OF 10

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	PROD REL ERO SD-0281	CL	4-84		4-84
B	INCORP ECO 17622	DMD	6/11/84		6-24-84

NOTES

1. A REFERENCE DESIGNATION SHOWN IN PARENTHESIS, E.G.; "(P6)", REFERS TO THE CORRESPONDING DESIGNATION FOR THAT ITEM ON ASSOCIATED DRAWINGS & PARTS LISTS.
2. INTERPRET DRAWING PER ANSI Y14.15a-1971

960587-001 REV. B

REV STATUS	REV	B			
OF SHEETS	SH	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE DECIMALS .X± .XX± .XXX± ANGLES± .
DO NOT SCALE DRAWING

	APPROVAL	DATE
DWN		4/11/84
CHK		4-18-84
DES ENG		4/18/84
SAFETY		4/18/84
DES MGR	—	
MFG ENG		4/19/84
ISSUED		4-19-84

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TITLE: WIRING DIAGRAM- MTSU

CODE IDENT	SIZE	DWG NO.	REV.
32274	D	960587-001	B

SCALE NONE | SH 1 OF 1

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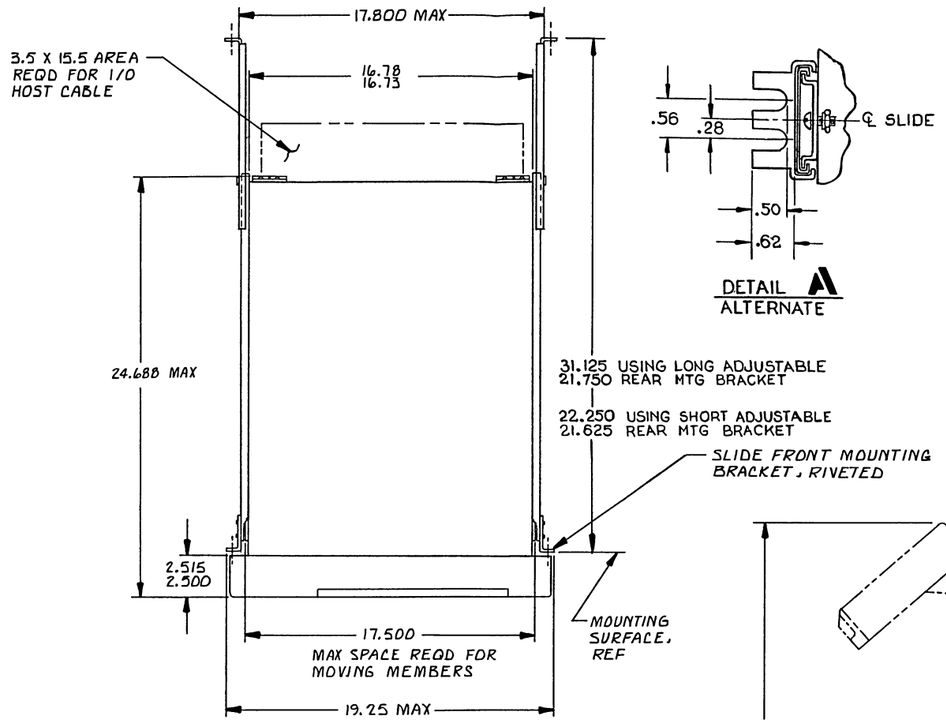
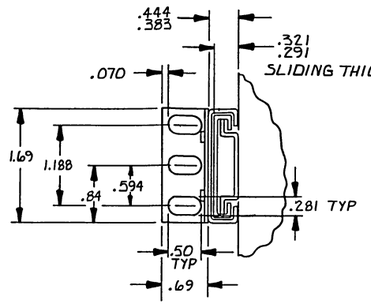
BRUNING 40-22

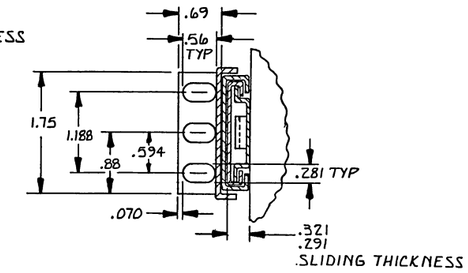
REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENG REL	LS	2/4/83	CK	3/4/83
B	INCORP ECO 16701	MH	9.1.83	SJ	11-7-83
C	INCORP ECO 17463	MH	5-18-84	XP	5-21-84
D	INCORP ECO 17622	DMD	6/4/84	XP	6-26-84



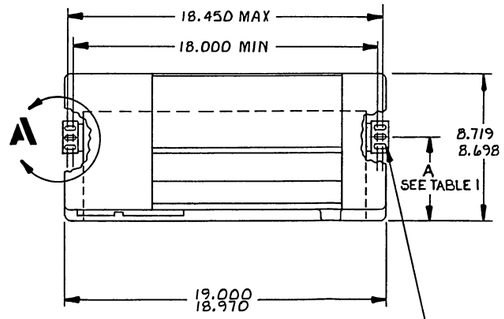
DETAIL A
ALTERNATE

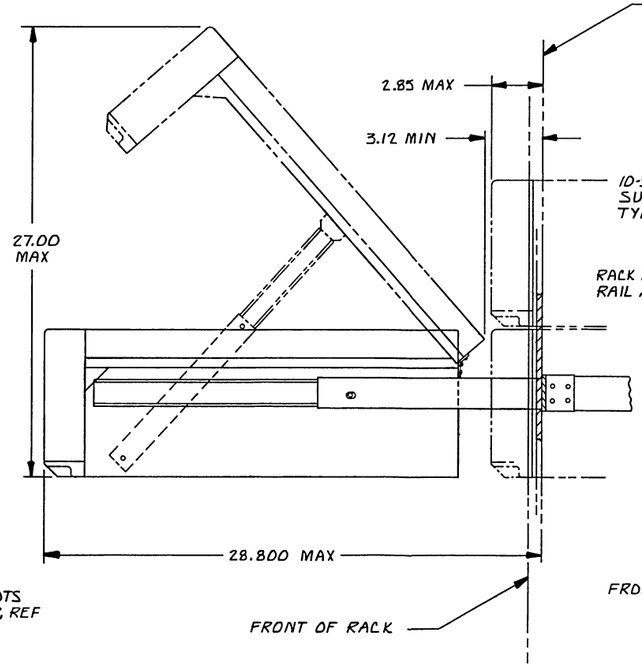


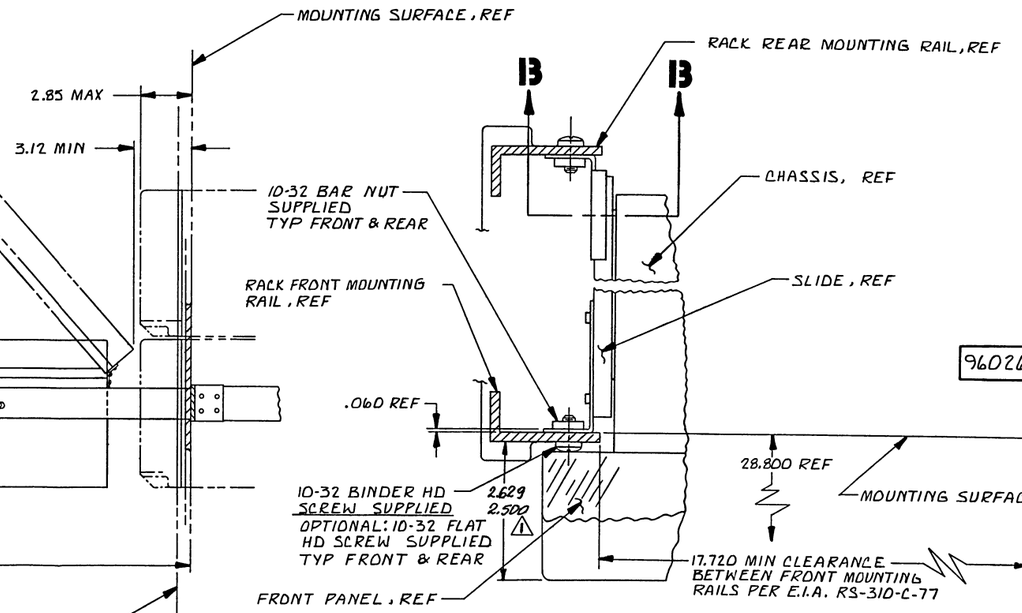
DETAIL A
(SEE ALT DETAIL A)



SECTION B-B
SCREWS & BAR NUT
OMITTED FOR CLARITY







TYPICAL INSTALLATION
THE F880 WITH SLIDES MOUNTED IS DESIGNED TO FIT INTO A STANDARD E.I.A. RS-310-C-77 RACK

NOTE:
⚠1 MOUNTING DIMENSIONS WILL VARY FROM 2.629 WITH A BINDER HEAD SCREW TO 2.500 WITH A FLUSH HEAD SCREW.

TABLE I - REF	
CHASSIS ASSY	DIM A
960566-001, -009 & -010	5.000 4.900
960566-002	3.972 3.872
960566-004	4.320 4.220

MECH		3/11/83
ELEC		3/11/83
CSA		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X± .1
.XX± .03
.XXX± .010
ANGLES±
DO NOT SCALE DRAWING

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APPROVAL	DATE
MECH	3/11/83
ELEC	3/11/83
MFG	3/10/83
RMEL	
QA	
MKT	
ISSUED	3/11/83

DWN 2/25/83 CHK 3-11-83

cipher data products, inc. SAN DIEGO CALIF

TITLE: MTSU-RACK MOUNT, INTERFACE

CODE IDENT	SIZE	DWG NO	REV
32274	D	960264-000	D

SCALE NONE MOD SH 1 OF 1

960264-000 REV D

BRUNING 4032